FOOD & NUTRITION

MONOGRAPH SERIES

FOOD & NUTRITION

EDITOR:

DR. P. R. REDDY

Professor & Head, Department of Home Science

SRI VENKATESWARA UNIVERSITY

TIRUPATI - 517 502

Printed with the aid of a grant from the U.G.C.

COPIES : 250

PRINTED AT
S.V. UNIVERSITY PRESS
TIRUPATI

FOREWORD

It gives me great pleasure to express my appreciation of the excellent research work carried out in the Department of Home Science, S.V. University, Tirupati under the dynamic leadership of Dr. (Miss) P.R. Reddy and reported in this monograph.

The monograph contains results of studies on various aspects such as (1) Nutritional status of selected groups of the population in Chittoor district; (2) Food consumption pattern surveys among selected groups of the population; (3) The nutritive value of some processed protein foods; (4) The nutritive value and acceptability of some hybrid cereals and legumes and (5) Use of some non-traditional foods in common food preparations.

The various studies have been planned carefully and carried out in a systematic and thorough manner. The results are presented and discussed in a clear and critical manner. The monograph has added considerably to our knowledge on the nutritional status of people in India.

I congratulate Dr. Reddy in planning the various studies (in guiding the different research workers) and in presenting the results in clear and lucid manner in this monograph. I am confident that this monograph will prove of immense use to students and research workers in the field of Community Nutrition.

M. SWAMINATHAN, D.SC., F.N.A.,
Formerly Chairman,
Applied Nutrition & Dietetics,
C.F.T.R.I.,
MYSORE.

PREFACE

Nutrition programmes of a preventive or remedial nature take on relevance to the food practices and the nutrient needs of communities, when the basis for the programmes is nutritional information obtained from field and laboratory research studies in the area of operation. The need for such investigations in Chittoor district was felt inorder that the lacuna of information necessary, for effective class room teaching and extension work in the communities, could be satisfied. The studies were planned and conducted by the staff and students of the post graduate department of Home Science, S.V. University over a period of eleven years (1965–1976).

The monograph contains the results of these microlevel explorations in five areas of Food and Nutrition. The first two areas include surveys of the nutritional status and food consumption patterns of specific community groups ranging from the preschoolers to adults, to the aged. The samples were from a rural or urban setting or both with differing socio-economic level. Though limited in sample size, the information obtained by these surveys gives a lead to action programmes in nutrition. Similar dietary patterns and nutritional status may be expected to prevail among people of a backward area such as that of Rayalaseema in Andhra Pradesh.

The third area consists of results from laboratory investigations on the biological value of several commercially processed protein foods such as fish proteins and leaf proteins. Results of biological evaluation of home processed (germinated) beans and pulses such as moth bean (Phaseolus Aconitifolius), green gram, cow pea, red gram and bengal gram are also reported. The information given can prove valuable in planning supplementary feeding programmes for women and children and in offering nutrition advice to special groups requiring proteins of high nutritive value. While conducting this type of work, the procedure for assessing the biological

value of proteins was standardized. Hence details of methodology are emphasized in the third chapter on the nutritive value of some processed protein sources from plant and animal kingdom.

The last two areas constitute a spectrum of laboratory investigations on assessing food quality in terms of chemical constitution, cooking properties and consumer acceptance. A variety of foods such as hybrid cereals and pulses, cane and palm gur, natural gelling agents and pork were tested systematically through carefully planned experiments. Both objective and subjective evaluations were done. The information presented in these chapters of the monograph is a significant contribution to the subject of experimental foods and cookery. Useful data is given on the nutrient content of some of the foods studied.

The contents of this monograph can serve as resource material for further research, teaching, training and extension programmes with special relevance to communities in Chittoor district.

DR. P. R. REDDY
EDITOR

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Introduction

The prosperity of a nation is reflected in the nutrition of its people. No country can rise to its full stature with half of its people subsisting on less than a square meal a day. It is an irony of our times, that an era of some of the greatest achievements has chronicled mankind's worst maladies viz., poverty, ignorance and malnourishment. Approximately, every third person in the world spends his day hungry and malnourished. The problem is acute in the underdeveloped or developing countries where most of the hungry mouths and malnourished bodies are congregated in millions. India, the country where we live, is still in the clutches of this monster, fighting hard to free itself from its abhorring tentacles.

There are conditions which seem to go with malnutrition. A large population, poverty, low production, ignorance and superstition appear to facilitate persistence of malnutrition and poor health. Poor health and malnutrition contribute to low production which in turn leads to national poverty. The vicious circle is complete. It is little realised that malnutrition can often be a cause for poor socio-economic development and that good nutrition would result in better and more efficient human inputs resulting in good socio-economic development. As McNamara (1973) put it succinctly, malnutrition saps energy, stunts the body and slows the mind. A sound mind which is the sap of the prosperity of a people cannot reside in an unsound body.

What is malnutrition? What are its ugly heads? and what does it cost the country? Answers to these questions should constitute the legitimate knowledge of every Indian citizen, for, it is public awareness of a national problem that would spur and catalyse institutional and non-institutional efforts at amelioration. The weed that is literally eating into the vitals has to be rooted out.

Malnutrition in common parlance may be understood as a state of the body characterised by a serious imbalance of nutrients. Both over and undernourishment are subserved under malnutrition. Technically malnutrition is defined as a pathological state resulting from a relative or absolute deficiency or excess of one or more of essential nutrients (Jelliffe, 1966).

The effects of malnutrition are myriad. For example, a major cause for the high maternal mortality in our country is maternal malnutrition. The high maternal mortality rate of 252 per 100,000 live births as against the insignificant 19.6 of Sweden, 25.9 of England and Wales and 33.1 of U.S.A. makes sad reading. Maternal mortality is only part of the story. The malnourished mother passes on the influence to her foetus. Maternal malnutrition during the later part of pregnancy has a telling effect on the baby to be born. The child's brain is liable to be irreversibly affected. Thus the malnourished mother gives birth to a psychological cripple.

Evidence is available to indicate that malnutrition is an important factor in the high infant mortality rates in developing countries. Infant mortality rate has been considered as an index of the general state of public health of a community. Though there has been a considerable decline in infant mortality rates in the last two decades, the present level of 69 per thousand in India is a figure far too large than what is observed in the technologically advanced countries like Sweden (13.3), Japan (18.5) U.S.A. (23.4) and Australia (18.2). This is a wastage of gestation and all the inputs that have gone into the heralding of the baby into this world, not to speak of the injury it would have caused to the maternal health.

India is a country with a teeming population and a low per-capita income. A large segment of this population is in its prime of life. With more than two third of the people living in villages mostly under conditions of poverty, ignorance and insanitation, the weaklings that are born to malnourished mothers are further exposed to the ravages of unkind living conditions of health, hygiene and habitat. The result is that a large number of children of the pre-school age suffer from the crippling blow of a variety of nutritional disorders and deficiencies namely anaemia, kwashiorkor and marasmus. It is a sad spectacle that a good chunk of the citizens of tomorrow grow in nutritionally underprivileged conditions. And poor nutrition leads to poor general health and a high susceptibility to infection which only saps further the limited stores of nutrients and stamina of the individual.

The incidence of malnutrition comes to light generally when its deleterious effects assume epidemic proportions to attract the medicine or public health man. This is a late stage when the problem becomes clinically serious. But the pre-deficiency states are of concern for prevention of the clinical manifestations. Surveys of nutritional status of vulnerable groups of population yield precious information such that adequate preventive steps could be thought of. Through some surveys the clinical cases could be identified and isolated for implementing remedial measures at the appropriate moment. Though the problem of nutrition

has been receiving increased attention during the last two decades, it is only recently that preventive measures are coming into focus. As Gopalan (1972) stated, the cost of treating malnutrition is much higher than its prevention. And this is after all true to the adage that a stitch in time saves nine.

Programmes of prevention or treatment of malnutrition have to be based on reliable and detailed information pertaining to the nutritional status of people, their dietary habits and the local availability of various types of foods. One of the important lacunae of many nutrition programmes is the lack of precise information of the actual incidence of the varieties and degree of malnutrition in an area. Micro-studies of segments of the population with regard to their nutritional status and common nutritional disorders help in the identification of localised problems. There is every need to assess these problems as they occur in localised pockets and execute prompt and meaningful remedial measures.

Rayalaseema in Andhra Pradesh is a backward region. With none too satisfactory an annual rainfall, a rocky soil, an industrially backward economy, agriculture at the mercy of an inconsistent and volatile monsoon and added to these with an impoverished ryot, who is decades behind in knowledge of agricultural technology, things could hardly be otherwise. It is against this back-ground that nutritional studies reported here take on relevance.

Good health, which is characterised by a state of complete physical, mental and social well being and not merely by the absence of disease or infirmity depends much on the food we eat or do not eat. The nutritional status of an individual reflects the degree of physical well being he enjoys. Technically speaking it refers to the condition of the body resulting from the utilisation of the essential nutrients available to it. The nutritional status of a person may be good or bad depending on the ingestion of dietary essentials and on the body's ability to absorb and utilise them. An optimum nutritional status would thus result from the intake of the essential nutrients viz., carbohydrates, proteins, fats, minerals and vitamins in adequate quantity and their being absorbed, stored and utilised efficiently.

Good nutrition is essential for normal organ development and function, for optimum activity and working efficiency, for resistance to infection and for the ability to repair bodily damage or injury. The demands on nutrients depend on the age of the individual, the quality and quantity of his activities, on the general condition of his health, and on certain special states such as convalescence, pregnancy and lactation. The nutritional requirements may, in addition, depend on the conditions of the locality where the individual resides.

Estimates of nutritional status of the community serve several purposes. Some of the more important uses of such surveys are that a) they help in the detection of the extent of various types of malnutrition that prevail in the community, b) it enables the proper planning of remedial or preventive measures, such as supplementation programmes, the popularisation of new and cheap foods that could be prepared from out of what is locally grown or available and c) thus contribute to the important result, the improvement of the quality of life of various segments of the community eg , children, adolescents, adults, the work–force, pregnant and lactating mothers, the old and the infirm. These lead in turn, to an improvement in the quality and quantity of work turn–over resulting in more efficient production and greater national development. Therefore the value of surveys of nutritional status can hardly be overstressed Such surveys become all the more meaningful and useful in underdeveloped regions of the country where, insanitation, ignorance and poverty abound and contribute to malrourishment

Rayalaseema is one such region where there is the added problem of unfavourable climatic condition. Some of the research work carried out in the department of Home Science, S.V.U. College, Tirupati, has particularly been focussed on this aspect. Several microstudies were carried out pertaining to the nutritional status of the various age groups in the rural areas in and around Tirupati.

Nutritional Status of Children with Special Reference to Pre-School Age

Of the 'seven ages' of man it is during childhood when the foundations of life continue to be laid, that malnutrition has a telling effect on the individual. Research has it, that good nutrition during the first few years of life is crucial to proper brain development. While nature has provided in the breast feed the balanced nutrition, be it at the cost of the mother's own health, it is among those who have been weaned early for various reasons that proper replacements of nutrients do not take place resulting in under–nourishment. Cow's milk and cereal foods, inadequately available to the poor rural people, hardly meet the requirements of the young child.

Rural children in pre–school years therefore are particularly likely to be prone to malnourishment. Most of them do not attend any school or nursery to come under institutional inspection of some kind. This is to some extent true even of children from the weaker sections of urban and semi–urban areas.

Pre-schoolers in India constitute 15 percent of the total population. The incidence of severe forms of protein-calorie malnutrition has been estimated to be around 1–2 percent among all children between the ages of 1–5 years. However, a very large proportion of children belonging to the low income groups are under-nourished (Gopalan, 1972).

Information on the general incidence of sub-clinical forms of malnutrition in Rayalaseema is limited. A few studies of the nutritional status with special reference to select groups of pre-schoolers (2–5 age group) only are available.

Prabhavati (1972) conducted a study to compare the plasma albumin and vitamin C levels of normal children and children with protein-calorie malnutrition The sample consisted of 12 marasmic, 12 kwashiorkor and 12 marasmic kwashiorkor children attending the S.V.R R. Hospital, Tirupati. The normal sample of 12 children was drawn from the healthy children attending the 'well-baby' clinic of the same hospital for immunisation and vaccination. There were both boys and girls in the sample and their age ranged between one and six years.

Plasma ascorbic acid was estimated using the method of Roe and Kuether with 2, 4 dinitrophenyl hydrazine re-agent as modified by Mohan Ram (1967). Albumin was estimated using the microkjeldahl method. In order to get an approximate idea of the food intake of these children, a questionnaire was used to interview the mothers. The results of the study are presented in table 1.

Table — 1

Mean levels of Plasma Ascorbic Acid and Albumin among Normal and Protein-Calorie Malnourished Children

S. No.	Type of children	Mean Plasma Ascorbic acid mg/ 100 ml.	't' value and level of significance	Mean Plasma Albumin mg/100 ml.	't' value and level of significance
1.	Normal (N=12)	0.50±0.07	6.55(1%)	4.25±0 26	3.36(1%)
2.	Marasmic (N=12)	0.33±0.05		3.25±0.11	
3.	Marasmic Kwashiorkor (N=12)	0.27±0.03	2.72(1%)	2.47±0.21	2.6 (1%)
4.	Kwashiorkor (N=12)	0.22±0.03	1.87(10%)	1.76±0.40	2.36(5%)

The plasma albumin and ascorbic acid levels of malnourished children were significantly lesser than those of the normal children. These children coming as they do from socio-economically backward families, their general intake of all nutrients was low. This was recorded in the diet survey. Low levels of nutrients combined with unsanitary conditions of living expose them to the ravages of malignant infections.

Severe protein malnutrition is known to produce an imbalance of the mineral elements in the body. Of these mineral elements so affected, zinc is one. Hair has often been used for assessing the zinc nutritional status among children. There are several good reasons for this, eg., easy availability, extractability, preservation, transportation and handling of the materials. The use of hair zinc as an indicator of protein nutritional status is of recent origin. Most of the early studies of hair zinc levels in relation to protein malnutrition were conducted outside India (Bradfield, 1972; and Bradfield and Jelliffe, 1970). Few studies on zinc levels of hair among normal and protein malnourished subjects in India have been reported. Local studies of the zinc levels in the hair of normal and kwashiorkor children are of relevance.

In an investigation conducted by Meenakumari (1973) at Tirupati, zinc levels among the malnourished children were estimated and related to their serum protein, serum albumin and dietary intake of protein. In a second study that was also conducted at Tirupati (Vimala, 1971), the levels of zinc in the hair of children 8–10 years of age in a semi–urban and semi–rural area were estimated and related to their dietary zinc intake.

The sample for the first study consisted of six boys and six girls (2–5 years of age) in each of the three age and economic status matched groups viz., those with severe kwashiorkor, those with moderate kwashiorkor and normals. Dietary intake of proteins was assessed by a quantitative diet survey for three successive days, immediately preceding the collection of blood and hair for analysis. Serum albumin and total proteins were assessed by using the procedure involving the Biuret reaction (Spectronic–20 Clinical methods manual 24, p63).

The sample of the second study consisted of 25 children from Chandragiri village (semi–rural) and 25 children from Tirupati town (semi–urban). Samples of their hair were collected.

In both studies, hair from the nape of the neck was epilated, exposed briefly to carbon tetrachloride to destroy parasites and cleansed of superficial deposits using soap solution and washed in demineralised water. It was dried and then stored in a clean, sealed polythene cover. The zinc in the hair was estimated by following the method outlined by Basu and Staff (1959). The results obtained in these two studies are summarised in the following table.

TABLE — 2

Hair Zinc Levels of Normal and Malnourished Children as Compared With Total Serum Proteins and Serum Albumin

S.No.	Criteria	Normal school children			Normal pre-school children	Kwashiorkor children	
		Semi-urban	Semi-rural	't' value		Moderate	Severe
1.	Hair Zinc levels mg/g.	278.20	141.36	20.89**	161.97	136.35	93.15
2.	Serum Albumin g/100 ml.	—	—	—	3.98	2.86	1.97
3.	Total Protein g/100 ml.	—	—	—	6.03	5.64	5.01

**Significant at one per cent level.

With regard to the hair zinc levels of school children, the data indicates a clear cut difference between the semi–rural and semi–urban children. The mean hair zinc value of semi–urban children is significantly higher than that of semi–rural children. The low values among the semi–rural children is attributed to their poor nutritional status. Relating the status to dietary intake it was found that the rural people do not consume zinc-rich foods such as animal foods and legumes as frequently as the semi–urban people. The semi–rural children mostly ate cereal foods. Some also had the habit of swallowing clay which binds zinc and makes it unavailable for absorption.

Data pertaining to the pre–school children brought out significant differences between the normal and kwashiorkor children in their hair zinc, serum albumin and total protein levels. The lower the protein status, the lower the zinc level in hair. The calculation of correlation between the intake of dietary protein and hair zinc levels of moderate kwashiorkor children indicated that the correlation was significant ($r = 0.719$). In the case of children with severe kwashiorkor, the correlation was positive, but not significant.

Zinc in human nutrition has several important roles to play (English, 1969). One of them appears to be that protein and zinc are interrelated and for the maximum utilization of protein, zinc is important. Proteins also seem to influence zinc metabolism. Recent research (Mills, 1972) has thus thrown light on this important trace element, zinc. Hair zinc levels offer a satisfactory means of assessing zinc status and protein status of an individual. This is particularly useful while conducting large scale field studies.

Nutritional Status of Elementary School Children

School children form an important vulnerable segment of the population and constitute about 20–25 per cent of total population in India Being the formative years, the nutritional status of the school going children ought to be satisfactory to enable them to cope with the heavy demands on the various nutrients.

Detailed surveys of the general nutritional status of the children of the age group 6–8 have not been many and few if any in the Rayalaseema area of Andhra Pradesh. Swarna (1974) from the Department of Home Science, S.V. University, carried out an investigation to asses the general nutritional status of a sample of school going children of the age group 6–8 years, belonging to the lower and upper middle income groups of the rural and semi-urban areas of Tirupati, Andhra Pradesh.

A sample of 48 children (24 boys and 24 girls) in the age group 6–8 years were randomly drawn from the total list of children of the low socio-economic status studying in rural and semi-urban elementary schools. Similarly a sample of 30 children (15 boys and 15 girls) representing the upper middle socio–economic level were randomly drawn from a school in the semi-urban area of Tirupati. Children of rural areas around Tirupati, representing the upper middle economic status were not included in the sample as they were not in adequate number. The following anthropometric measurements of the children were recorded using procedures described by Weiner and Lowie (1969).

a) Standing height, b) Sitting height, c) Weight. d) Chest girth, e) Hip girth, f) Arm circumference, g) Head circumference and h) Skinfold thickness.

All the average anthropometric measurements were higher for the children of upper middle income group, as compared with those of the children of lower middle income group. All these measurements are influenced by total calorie and protein nutrition and thus there is a close relationship between anthropometric measurements and the diet. The upper middle income children were better off in their nutritional status, when compared to the children of the lower economic status.

Nutritional status was assessed on the basis of clinical symptoms of nutritional deficiencies using the proforma given by Jelliffe (1966). Hair, face, eyes, lips, tongue, teeth, gums, nails and skin were observed. In addition, Vitamin A deficiency was assessed through a dark adaptation test. Haemoglobin level was assessed from blood samples using a Haemoglobinometer. The dietary intake of nutrients was calculated through a quantitative diet survey of the food intake of the child for three

consecutive days. From this data the total intake of calories, protein, fat, calcium, iron, Vitamin A, thiamine, niacin and ascorbic acid was calculated. The percent incidence of nutrient deficiency symptoms in the rural and urban samples is recorded in table 3.

TABLE — 3

Total Percent Incidence of Deficiency Symptoms in Children (Low economic group) from Semi-urban and Rural Areas

Deficiency symptoms	Percent Incidence			
	Semiurban		Rural	
	No. of cases	Percent	No. of cases	Percent
Pale conjunctiva	25	52.0	19	39.5
Bitot's spots	3	6.3	6	12.5
Xerosis of cornea	4	8.3	1	2.0
Conjunctival Xerosis	5	10.6	4	8.3
Angular stomatitis	20	46.0	18	28.0
Angular scars	2	4.2	—	—
Mottled enamel	6	12.5	21	44.0
Bleeding gums	14	29.0	6	12,5
Hyper keratosis	22 (Mild)	46.0	5 (Moderate)	10.4
Follicular hyper keratosis	2 (Moderate)	4.2	6 (one severe)	12.5
Dermatitis	—	—	10	20.9
Total number of the sample			48	

The manifestation of iron deficiency in the form of pale conjunctiva was widespread in the children. Vitamin B complex deficiency, particularly riboflavin deficiency was observed in 46 and 28 percent of semi-urban and rural children respectively. Regarding skin lesions, 46 percent of the semi-urban children and 10.4 percent of the rural children showed mild hyperkeratosis. This data illustrates the fact that many of the children studied, showed nutrient deficiency symptoms.

The average percent haemoglobin values of all these children ranged from 7.0 to 10.0 g/100 ml. Children of upper middle income group had values around 9 to 10 g. However, children of lower income families had around 7.8 to 8.5 g/100 ml. Lower values of haemoglobin suggest that these children were positively anaemic and required immediate treatment. Symptoms like pale conjunctiva, pale tongue and spoon shaped nails observed among these children confirm the fact that iron deficiency anaemia is prevalent and needs to be treated.

The results of diet survey provided data pertaining to the average intake of nutrients by the children from the rural and semi–urban areas and belonging to lower middle and upper middle income groups. Table 4 gives an analysis of this information.

The results confirm the fact that the diets of children from lower income families are far below the recommended allowances and consequently these children suffer from malnutrition. Calorie and protein deficiencies are marked in the diets along with vitamin deficiencies. There is an urgency to improve the quality and quantity of the diets of this vulnerable group of the population so that the future manpower is not at stake.

Among the various ways malnutrition is to be combated, one would be to supplement the dietary intake by nutrient rich food. How do these supplements work ? Do they bring about any significant change in the nutritional status of these people ? In a study at Ullepatteda village, near Tirupati, the effect of a nutritional supplement (Multipurpose Food – MPF) on a sample of children was investigated (Sarojini, 1967). Thirteen rural children 6–8 years and of low socio–economic status were selected. The food consumption of the child was recorded through a diet survey. The baseline nutritional status of the child was assessed through

(a) Anthropometric measurements of height and weight
(b) General clinical examination and
(c) Blood tests.

The general clinical examination relevant to nutritional status consisted of the examination of the condition of the hair, the eye (conjunctivae), the skin, the teeth and other external signs of nutritional deficiencies. The blood tests consisted of RBC count, haemoglobin estimates and packed cell volume. From these the mean cellular volume and the mean cellular haemoglobin concentration were calculated.

TABLE — 4

Average Intake of Nutrients by Three Groups of Children compared with Recommended Allowances of the Nutrients

Age	Group of children	Calories	Protein g	Fat g	Calcium g	Iron mg	Vit A IU	Thia. mg	Ribo. mg	Nia. mg	Vit C. mg
	*Recommended allowances	1500	22	...	0.4–0.5	15 0	2000	0.8	0.8	10	30
	1) Children of upper middle income group (semi-urban)	1799	26	22.9	0 67	20.2	1900	0.6	0.6	13	41
6+	2) Children of lower middle income group (semi-urban)	863	18	12 1	0.22	9.2	390	0.5	0.4	4	21
	3) Children of lower middle income group (rural)	979	16	13.5	0.25	8.6	396	0.3	0.3	4	9
	* Recommended allowances	1800	33	...	0.4–0.5	15.2	2600	0.90	0.90	12	30
7	1) Children of upper middle income group (semi-urban)	2045	43	38.3	0.83	37.0	3500	0.77	0.70	13	43
and 8+	2) Children of lower middle income group (semi-urban)	1661	24	17.7	0.34	10.6	714	0.56	0 44	6	17
	3) Children of lower middle income group (rural)	1193	26	19.0	0.33	11.7	574	0.53	0.41	5	12

* Gopalan, C. and Narasinga Rao B.S. (1971) Dietary allowances of Indians. NIN, ICMR, P. 84.

The children, after the initial nutritional status assessment, were given two ounces of nutritional supplement (MPF) every day in the form of three laddus. The recipe laddu was selected on the basis of a preliminary study of acceptability of four recipes (viz. Laddu, Murukku, Vadai and Conjee) prepared with the MPF. The laddus were prepared with MPF, sugar and vanaspathi. Children were fed with this supplement for seventy days. On completion of this supplementation, their nutritional status was reassessed and changes if any were noted.

Prior to the protein supplementation, the average intake of calories was 1173, average intake of protein was 35.5 gms. and the protein-calorie ratio was 11.8. After supplementation, these values increased to 1670, 59 gms. and 14 respectively. Similarly the fat intake increased from 15.9 to 35.9 gms. Calories from fat increased from 143 to 323; fat-calorie ratio increased from 13.1 to 19.3 and the iron intake increased from 17.59 mg. to 20 mg. Similarly increases were recorded in Vitamins A and B Complex.

The common nutritional deficiency symptoms observed prior to supplementation, like angular stomatitis, deficient subcutaneous fat, lack of lustre in skin and hair, bitot spots, angular conjunctivitis, xerosis, vascularisation of cornea, oedema, bleeding gums and anaemia showed considerable improvement.

The mean weight of the thirteen subjects increased from 16.2 kgs. to 17.5 kgs. and height increased from 111 to 113 cms. The weight increase was statistically significant while the height increase was not.

The blood picture before and after supplementation is given in table 5.

TABLE — 5

The Blood Picture of Rural Children Before and After Supplementation with Multipurpose Food

Sl.No.	Blood values	Before supplementation	After supplementation	Percent improvement	Significance of difference
1.	Haemoglobin g/100 ml	8.64	10.81	28.9	Significant at one percent level
2.	R.B.C. (million/cmm)	3.16	4.03	30.3	–do–
3.	Packed cell volume per 100 ml. blood	33.40	39.00	17.9	–do–
4.	Mean cell volume (MCV) in microns	112.96	97.63	...	Not significant
5.	Mean cell Haemoglobin (MCH) in micrograms	28.59	27.02	...	Not significant
6.	Mean cell Haemoglobin percent (MCHP)	25.79	28.23	...	Not significant

The data in table 5 indicates that there was a significant increase in haemoglobin, RBC and packed cell volume after supplementation. But the differences in MCV, MCH and MCHP were not significant.

The results of this study thus point out that the MPF supplement brought on significant improvement in the general nutritional status of the children studied even during the short period of 70 days of the experiment.

Convincing evidence is thus available indicating the urgency with which efforts to tackle the problem of malnutrition must be taken up. A variety of nutrition programmes must be implemented in all the schools, taking care of at least one third the nutritional requirements of the school going children.

Studies on the nutritional status of College girls

The attitudes of women students towards food may be interesting. Young women, overconscious of their figure, may coax themselves to consume meagre amounts of food for the fear that they may add unwelcome fat to their flesh. A logical result of this inadequate intake could be a short fall in some essential nutrients eg. proteins, vitamins and minerals. And then, there is the characteristic "Indian woman syndrome", that of anaemia. All these and others make the nutritional status assessment of college girls in hostels interesting and invaluable

Today, considerable interest is being evinced on the nutritional status of college women. Nutritionists feel that information on this aspect is too meagre and that existing dietary standards are not well fitted to college women in this age group, especially so with regard to calorie requirement.

A study was carried out to assess the basal metabolic rate of college girls (residing in S.V.U. Women's Hostel, Tirupati) and to relate the same to their height, weight, calorie intake and average energy expenditure (Sastry, 1971).

The sample consisted of 35 young women between 18 and 22 years of age. To select the sample, initially, the heights and weights of all the 131 students in the hostel were mesured. From this, the weight ranges 36–38 and 40–48 kg. which showed the highest frequency were selected. The average height of the subjects in each weight range was determined and three groups were formed, one consisting of persons above the average, the second of those below the average and the third of those of average height. This was done to study the effect of height (in each weight range) on the Basal Metabolic Rate (BMR). To study the effect

of weight on BMR, the average height of the subjects in the hostel was taken and five subjects of this height (±1″) with different weights were drawn at random.

BMR was measured in the laboratory. Readings were taken in the morning before breakfast after resting the subject for 30 minutes. The immediate pre-and post-menstruation periods of subjects were avoided. Temperatures and pulse rates were recorded during the rest period and when individuals recorded temperature of 99 and above, the experiment was postponed. The BMR was measured using the Toshniwal Expirograph apparatus based on the volume of oxygen used. The body surface area was calculated from Banerjee's modification of Dubois height-weight formula (Banerjee S.S. and Mahendra S.K., 1962, Ind. J. Med. Res. 50, 771).

Daily energy expenditure was calculated from the record maintained by the subject of her activities (averaged from three days consecutive record). The metabolic cost of their activities was calculated using standard tables.

The intake of calories was determined from the record of food consumed for these three days. Raw-cooked weight conversion factors for the foods prepared in the hostel were calculated and this factor was applied to the weights of cooked foods consumed and from the raw weights thus obtained, the caloric values of the foods consumed were calculated. The average calorie value of the food consumed per day was obtained by averaging the three day intake.

The basal metabolic rates of subjects of given heights and weights are shown in table No. 6.

TABLE — 6

Basal Metabolic Rate, Height and Weight of College Girls in S.V.U. Women's Hostel, Tirupati

Sl. No.	Group	Mean Height in Cms.	Mean Weight in Kg.	Mean BMR Calories/M²/hr.
1.	I	152.8	36.9	31.41
2.	II	155.7	40.8	32.01
3.	III	155.7	40 6	32.35

The first group consisted of subjects who were of varying weight but within a weight range of 36–38 Kg. The second group consisted of subjects who were also of varying weight but within a weight range of 40—42 Kg. In the third group the heights were constant i.e. 155.7±1,

while the weights of the subjects varied. It could be seen from the data that as the height and weight of the subjects increased, the BMR also increased.

Table 7 gives the total daily intake and expenditure of calories of the subjects.

TABLE — 7

Total Daily Intake and Expenditure of Calories of Girls of S.V.U. Women's Hostel, Tirupati.

Group	Average caloric intake	Average calorie expenditure
I	1610	1352
II	1652	1531
III	1528	1478

It is seen from the table that with increase of weight from 36-38 Kgs. (Group I) to 40–42 Kgs. (Group II), there is an increase in calorie intake. In Group III where height is in a fixed range but weights varied, this trend is not seen.

From further analysis of variance conducted, it was observed that only height individually had a significant influence on the basal metabolic rate. On an average the energy expenditure of the sample was between 1400 and 1600 calories per day.

Day to day variations in the weight of a woman is influenced by several factors. An investigation was conducted by Meera (1966) to study the variations in body weight of young women during the menstrual cycle and to examine the influence of the stress of terminal examinations and dietary intake on the day to day variations in weight.

The subjects for this study were drawn from Sri Padmavathi Women's College Hostel, Tirupati. 50 subjects who were 17–18 years of age and 50 subjects who were 18 -19 years of age were selected to make a total sample of 100. Care was taken to see that they were all keeping good health. Of the total sample taken, only 83 students could complete the experiment and therefore the results pertaining to these 83 subjects only was presented. Ten of these subjects were chosen for a second experiment viz., to study the effect of examination stress and ovulation on weight change.

The subjects were weighed every morning between 6 and 8 and in the evening between 4 and 6. Information regarding menstruation was obtained from the subject. The approximate time of ovulation was

determined by rise in body temperature. The results of the study showed that over a period of 30 days, the changes in weight ranged from 0.25 to 1.0 kg., with 0.5 kg. variation in most cases.

There was an increase in weight during menstruation, the weight gain commencing on the first day of menstruation, reaching a peak during the third day and a return to the original weight occurring a little after cessation of menstrual flow. The average weight increase was a little over 0.5 kgs.

There was a reduction in the calorie intake during menstruation. On scrutiny of dietary data it was observed that some skipped certain dishes while a few others skipped the meal itself. Normalcy was restored on cessation of menstrual flow.

Just as in the case of menstruation, the effect of ovulation was to produce a small increase in weight. Excercise in the form of N.C.C. parades brought a reduction in weight.

What was the effect of examination on weight variation? It was found that there was a reduction in weight during the examination period. It may be assumed that the weight reduction may be due to examination stress and consequent reduction in food intake at this period.

Yet another study was carried out (Aarif, 1972) on the young women of S.V.U. Post Graduate Hostels, Tirupati, to (a) assess the plasma ascorbic acid levels, (b) relate the same to their dietary intake of ascorbic acid, (c) to assess the haemoglobin and albumin levels and (d) to ascertain the relationship between Vitamin C and Iron. In addition, an attempt was made to study the relationship between haemoglobin levels and plasma ascorbic acid at different stages of the menstrual cycle.

Sixty five volunteer subjects, age and sex matched, and not suffering from moderate or severe anaemia were enlisted for the study. Of these, 55 subjects (randomly drawn) were used for the first part of the experiment and ten subjects were used for the second part of the experiment. All the subjects were drawn from S.V.U. Women's hostel. The first part of the experiment consisted of determining the plasma ascorbic acid levels and the haemoglobin and albumin levels of the 55 subjects. In the second part of the experiment the ten subjects were divided into two groups. For subjects of group I, plasma ascorbic acid levels, haemoglobin levels and albumin levels were studied at 5 day intervals of a menstrual cycle for a period of two months. For group II subjects, a similar estimate was made, but the subjects were given a supplement of 500 mg. of celin (Ascorbic acid) tablets.

Plasma ascorbic acid was estimated using the Roe and Kuether method. For estimation of albumin in plasma, the Micro-Kjeldahl method was used. The dietary intake of proteins and ascorbic acid was estimated by determining the same from the actual food intake of the subjects for three randomly chosen days in a week. The Micro-Kjeldahl method was used for estimating the protein intake while the titrimetric method was used to analyse the vitamin C content of the food.

The plasma ascorbic acid levels of the 55 subjects of part I of the experiment ranged between 0.251 mg./100 ml. and 0.5 mg./100 ml. with an average of 0.36 mg. / 100 ml. The slightly low levels observed might be due to poor ascorbic acid nutrition. The plasma albumin levels ranged from 3.7 to 6.0 g./100 ml. with an average of 4.76 g. / 100 ml. The albumin levels are in the normal range reported to be 2.4 to 6.5 g./100 ml. The haemoglobin levels of the subjects ranged from 10.5 to 13.5 g percent.

The plasma ascorbic acid and the haemoglobin levels were found to be correlated as also plasma ascorbic acid and albumin levels.

The dietary intake of protein of the sample did not grossly differ from the recommended allowances, but the dietary intake of ascorbic acid of the subjects fell short of the recommended allowances.

Results from the second part of the study indicated that haemoglobin levels decreased on the 5th day of the menstrual cycle and gradually rose again to reach a level equal to the premenstrual level. The ascorbic acid values decreased as the haemoglobin levels rose indicating a better utilisation of iron in the presence of ascorbic acid. A similar relationship was found between albumin levels and ascorbic acid levels through the menstrual cycle. With supplementation of vitamin C, the rise in haemoglobin levels and albumin levels was found to be greater than in the case of those who did not have ascorbic acid supplementation. Ascorbic acid aids in the incorporation of iron into the haemoglobin molecule. Ascorbic acid has also been shown to play a fundamental role in the synthesis of liver protein by enhancing the utilization of circulating amino acids. The inverse correlation between ascorbic acid levels and haemoglobin and albumin levels in the plasma could be due to these factors.

The high incidence of anaemia starts early among adolescent girls which suggests that the iron deficiency state observed during adulthood, particularly in women, is mostly an aggravation of the precarious iron nutritional status with which these subjects reach adulthood. Vijaya-

lakshmi (1976) planned a study to assess the iron nutritional status in girls at pre-menarche (12 to 14 years) and post-menarche (17 to 19 years) age. Thirty girls were selected in each group for the study. The parameters studied were levels of haemoglobin, serum iron, total blood proteins, albumins and globulins. The iron status of the subjects was correlated with their body weight, intake of calories, protein, iron and vitamin C. Further, the post-menarche group was divided into three groups of ten each to assess the effects of supplementation with the related nutrients on the iron status of the girls. The first group was supplemented with 60 mg. of ferrous sulphate, the second group with 200 mg. of vitamin C and the third group with 60 mg. ferrous sulphate along with 200 mg. of vitamin C as tablets. This supplementation was carried out for a period of one month. After this period the blood samples were analysed again for the biochemical parameters.

Haemoglobin was estimated by haemoglobinometer and by the cynomethemoglobin (Crosby et al, 1965) method for purposes of comparison. Serum Iron was estimated by the standard $\alpha - \alpha$ dipyridyl method (Ramsay, 1957). Total serum proteins, albumins and globulins were estimated by the standard method given by Reinhold (1965).

The results of this study are given in tables 8 to 10.

TABLE — 8

Mean Values of Haemoglobin, Serum Iron, Serum Protein and Albumin Globulin Ratio of Pre and Post-Menarche Girls

S.No.	Particulars	Pre-Menarche		Post-Menarche	
		Mean	Range	Mean	Range
1.	Haemoglobin. g/100 ml.				
	a) Haemoglobinometer method	9.04± 0.5	8.2–10.1	8 99± 0.66	8.0-10.2
	b) Cynomethemoglobin method	11.98± 0.8	10.9–13.1	12.23± 0.94	9.5–13.6
2.	Serum Iron. mg/100 ml.	39.58± 16.0	14 5–65.0	56.10± 20.40	23.3-88.6
3.	Total serum proteins. g/100 ml.	6.93± 0.60	3.9– 7.8	7.70± 0.46	6.3– 8.4
4.	Serum albumins g/100 ml.	2.88± 0.36	2.1– 4.0	3.62± 0.30	2.8– 4.0
5.	Serum Globulin g/100 ml.	4.00± 0 60	3.0– 5.5	4.10± 0.39	3.3– 4.9
6.	Albumin Globulin ratio	0.73± 0.34	0.38–1.1	0.89± 0.21	0.6–1.11

TABLE — 9

Mean Nutrient Intake and Body weight of Pre and Post-Menarche Girls

S.No.	Particulars	Daily Recommended Allowances	Post-Menarche		Pre-Menarche	
			Mean	Range	Mean	Range
1.	Calories (Kcal)	2200	1439± 164	1084-1684	1626± 167	1396-2046
2.	Protein (g)	50	29.8± 4.2	19.0-37.4	34.1± 6.5	24.5-52.4
3.	Iron (mg.)	35	12.3± 2.1	9.0-15.7	13.4± 2.4	9.2-20.1
4.	Ascorbic acid (mg)	30-50	31.4± 5.7	9.1-40.8	28.6± 9.1	16.1-44.8
5.	Weight (kg.)	—	29.4± 3.8	23.5-34.0	41.2± 4.72	35.0-39.0

TABLE — 10

Effect of Supplementation with Iron and Vitamin C on the Blood Picture of Post-Menarche Girls

S.No.	Supplements	Haemoglobin gr/100 ml		Serum Iron mg/100 ml		Total Serum Protein gr/100 ml		Serum Albumin gr/100 ml		Serum Globulins gr/100 ml	
		Before	After	Before	After	Before	After	Before	After	Before	After
1.	Iron	12.36	13.12	44.4	82.7	7.6	7.7	3.4	3.4	4.3	4.4
2.	Vitamin C	12.50	13.07	63.0	84.0	7.9	7.9	3.8	3.8	4.1	4 1
3.	Iron+Vitamin C	11.75	12.89	61.0	83.7	7.5	7.5	3.6	3.6	3.9	3.9

The haemoglobin levels of pre–and post-menarche age girls did not differ significantly from each other. Serum iron levels were higher in post–menarche group and the difference was significant at the one percent level. In spite of these high values, these girls were still at the anaemic levels i.e. below normal levels. The post-menarche group of girls had higher serum proteins and albumins and albumin globulin ratios compared to the pre–menarche group. The differences were significant

As per the data presented in table–8, there is no indication of the decreasing effect of menstruation on biochemical parameters. This could be due to various reasons. The quality and quantity of food consumption is different for the two groups. The diet of the post–menarche group was better than that of the pre–menarche group. Growth is more in pre–menarche as compared to post–menarche period. To meet the demands of the higher growth during pre–menarche period, more nutrients need to be provided in the diet, whereas the diet of the pre–menarche group provided nutrients below recommended levels. Moreover this is a cross–sectional study, where–in certain variables cannot be controlled.

The diets of the pre–and post–menarche group of girls (table – 9) were found to be deficient in calories, proteins, iron and ascorbic acid as compared to the recommended allowances of these nutrients for these age groups. However, the post–menarche girls had generally a better diet than the pre–menarche group.

The supplementation with iron and vitamin C either individually or in combination brought about similar improvement in serum iron and haemoglobin levels (table – 10). A month of supplementation was evidently sufficient to improve the iron nutritional status of the post menarche group of girls. This indicates, that through supplementation programmes and nutrition education, particularly to this group, the incidence of anaemia can be controlled among school and college girls.

Iron deficiency anaemia may be present due to various reasons, such as inadequate dietary iron, presence or absence of factors, which influence iron absorption and utilization and the type of source of dietary iron. Phytic acid and phytates form insoluble and unabsorbable iron salts in the intestine and interfere adversely with iron absorption. A large proportion of the total phosphorous in cereals and pulses is mainly in the form of phytin phosphorous. Even the iron of green leafy vegetables is not properly absorbed. The absorption and utilization of iron is facilitated if a balanced diet is consumed. The better quality and increased quantity of dietary protein, dietary ascorbic acid and traces of copper contribute to better iron absorption. A mixed diet including foods from all food groups is therefore recommended for a healthy body.

Nutritional Status of Pregnant Women

The foregoing studies throw light on the nutritional status of the younger groups of the population. The most vulnerable to malnutrition and the crucial group from the nutrition point of view, is that of the pregnant women.

Women of child bearing age (15–45 years) represent 21.2 per cent of our population. At a given time it is estimated that there are 20 million pregnant women. The majority of them belong to the poor socio-economic group. Surveys indicate a high incidence of malnutrition among pregnant women of the poor economic group. Maternal malnutrition is responsible not only for high maternal mortality but is also an important factor in influencing the nutritional status of the off-spring. Of the pregnant women examined in a survey carried out by scientists at National Institute of Nutrition (NIN) in South India (1964), 43 per cent showed one or more signs of malnutrition. A major cause for the high maternal mortality in our country is maternal malnutrition. Ten to twenty per cent of maternal deaths are known to be due to nutritional anaemias. The maternal mortality rate per 100,000 live births in India is 252.0 whereas in Sweden it is 19.6, in England and Wales 25.9 and in U.S.A. 33.7. Nutritional anaemia is a major public health problem in India, particularly among expectant mothers (Nutrition Atlas of India, 1971). Anaemia has been reported to be the highest among pregnant women of the low socio-economic group and more so in their third trimester.

Swarnakumari (1973) conducted a study to assess the iron nutritional status of pregnant women, who were in their second and third trimesters of pregnancy and belonging to lower and upper middle income groups.

Thirty pregnant women in their second trimester (fifteen from the high income group and fifteen from the low income group), thirty women in their third trimester of pregnancy (fifteen from the low and fifteen from the high income groups) and twenty non-pregnant normal women (ten from the low and ten from the high income groups) constituted the sample. They were drawn by random sampling from their respective groups from among those who attended the antenatal clinics in and around Tirupati. Their age ranged from 25 to 35 years.

Blood samples were collected in the morning of a day. A quantitative record of the diet of these women was obtained for the three days preceding the day when blood samples were collected. In the blood samples, the haemoglobin was estimated by the cyanomethemoglobin method[1], the serum iron was estimated by the method outlined by Peters

1. Hawk's Physiological Chemistry., Chap. 29, Blood Analysis. P 1096

et al[2] (Peters, Giovanniello, Apt, and Ross (1956)., J. Lab. Clin. Med., 48, 280; Muelling (1957)., Ame. J. Clin. Patho; 27, 97) and the total iron binding capacity by the method outlined by Ramsay et al[3] (Ramsay (1957)., Clen. Chem. Acta; 2, 221)

The results of the investigation showed that non-pregnant women in the low income and high income groups differed slightly in their haemoglobin levels. Pregnancy brought about a reduction in the haemoglobin levels. But there was significantly greater reduction in these levels among the women from the low economic group than among those belonging to the high economic group. The data is presented in table – 11.

TABLE — 11

Haemoglobin, Serum Iron and Total Iron Binding Capacity in Pregnant and Non-pregnant Women Belonging to low and High Economic Groups

	Low Income Group			High income group		
		Pregnancy			Pregnancy	
	Non-Pregnant	Second trimester	Third trimester	Non-Pregnant	Second trimester	Third trimester
Haemoglobin gr/100 ml	12.32	8.49	7.27	13.27	10.94	10 17
Serum Iron mcg/100 ml	105.12	55.68	36.40	122.79	93.70	73.50
Iron binding capacity mcg/100 ml.	375.23	412.30	362.80	382.24	371.10	390.00
Percent iron saturation	28.33	13.50	10.20	32.32	23 40	19 40

It is evident that along with haemoglobin, there is also a reduction in serum iron and percent iron saturation values in pregnancy, especially in the third trimester. If the total iron binding capacity is found to be above 350–450 mcg/100 ml., it indicates iron deficiency state. All the women studied irrespective of economic status were found to be iron deficient. From the data, correlations between the haemoglobin levels of various groups and parity was calculated. The correlations between parity and haemoglobin levels among the low income and high income groups were 0.77 and 0.44 respectively indicating that the higher the parity the lower the haemoglobin levels and *vice versa*. Both correlations were highly significant.

2. Hawk's Physiological Chemistry, Chap. 29, Blood Analysis P 1101
3. „ „ „ „ P 1102
Edited by Oser, B.L. (1965) 14th edi. McGraw Hill Book Company, New York, Toronto, Sydney, London.

Also a multiple regression equation relating haemoglobin to parity, protein and iron was fitted for the low income group women. The obtained equation was

$$Y \text{ (haemoglobin)} = -0.7727\ X_1 \text{ (Parity)} + 0.05\ X_2 \text{ (Protein)} + 0.08\ X_3 \text{ (Dietary iron)} + 8.5 \text{ (Constant)}$$

It is evident from the equation that parity was highly related to the haemoglobin status of the women than any of the other variables studied.

The foregoing results give a clear idea that the iron status of women of low economic strata is unsatisfactory. This situation cannot be allowed to continue. There is thus an urgency to implement programmes to supplement maternal nutrition, and as a long term measure to limit births and space them.

How does a programme of supplementation affect the nutritional status of pregnant women? Sarala Devi (1967) conducted a study to assess the dietary intake and nutritional status of pregnant women in their third trimester. The effect of supplementing their food with a high calorie-protein supplement as laddus (prepared with multipurpose food (MPF), Vanaspati and sugar), and iron was studied. Changes in the general nutritional status and blood picture consequent on the supplementation was examined. The birth weights of babies of those who had taken the supplements were compared with those, who did not have the supplement.

Of the 20 members belonging to the low socio-economic level, only 9 members completed the experiment and the other 11 withdrew from the investigation for various reasons. Of the 9, five subjects had MPF and iron supplementation while four subjects had MPF supplementation only. The MPF supplement contained 20 g. of MPF, 20 g. dalda and 30 g. sugar made into three laddus. The subjects were given these supplements for a period of sixty days.

The blood of the subjects was analysed prior to and at the end of the supplementation programme with regard to RBC, haemoglobin and packed cell volume and estimations were made of total proteins and total albumin in the serum. The total serum proteins and albumin were estimated using the biuret reaction.

In addition, a survey of the diet consumed by the pregnant women was done by an estimate of nutrient intake based on the food taken in the preceding 24 hours. The birth weights of infants of mothers who took the supplement were compared with infants of nine mothers of a similar economic group, who did not take the supplement.

The results of the diet survey showed that before supplementation the mean intake of almost all the nutrients was far below the recommended allowances. The physical examination of the subjects prior to supplementation showed that their general condition was poor. Supplementation improved the condition of the skin and reduced edema and neurological symptoms, where present.

The blood picture of the subjects prior to and after supplementation with MPF plus iron for a period of 60 days is given in table No. 12.

TABLE — 12

Mean Blood Values of Pregnant Women Prior to and After Supplementation with Multipurpose Food Plus Iron

S. No.	Blood value Studied	Basal	Supplementation		Percent Improvement
			30 days	60 days	
1.	RBC millions	2.7	2.9	3.1	15
2.	Haemoglobin g/100 ml.	6.8	8.2	8.8	29
3.	Hematocrit	31.6	33.0	35.0	11
4.	Serum Protein g/100 ml.	4.4	5.2	5.3	20

Suguna kannan (1971) conducted another investigation on pregnant women. This pertained to their ∝ tocopherol and Vitamin E status. Serum tocopherol levels of cord blood as well as maternal blood were determined to see how far these two were related. The mothers were from a low socio-economic group residing in and around Tirupati. An attempt was also made to relate Vitamin E status and birth weight and to study the infant feeding patterns of these mothers to see whether the supplementation with the artificial Indian infant foods would be of help in improving the Vitamin E nutriture of the child.

The cord blood was drawn from forty two infants at the time of their delivery at the Government Hospital for Women and Children, Tirupati. The entire sample was drawn from this hospital only. Maternal blood was drawn only from 30 mothers of these infants as in the rest of the cases the mothers were too anaemic. The cord blood was drawn from the umbilical cord. The umbilical cord was clamped and divided a few minutes after delivery and 6 ml. of the blood was collected in sterile centrifuge tubes from the placental end of the cord. The sample from the mother was obtained from the vein either immediately or a little after the delivery of the placenta. The blood thus collected was centrifuged at 2000 RPM for 15 minutes and serum was transferred to

a narrow mouthed test tube. The air space in the test tube was filled with nitrogen. Then it was stoppered and stored at —5°c for analyses which was done within 7 hours. The tocopherel in the blood serum was analysed by α— α_1— dipiridyl method as given by Baker based on the Emmerie Engel reaction (Baker, H., O. Frank (1968) "Clinical Vitaminology" Chap. 12. p. 169–175. Inter Science Publishers). The feeding patterns were studied through a questionnaire. As many of the mothers, who gave blood for analyses and some others were interviewed to make a total sample of 38.

Of the thirty samples of maternal blood drawn, seven samples were disregarded since technical errors occurred in the analysis of Vitamin E. The serum Vitamin E concentration of the maternal blood ranged from 0.08 mg. per 100 ml, to 2.77 mg. per 100 ml. with an average of 0.78 mg. per 100 ml. The cord blood Vitamin E concentration ranged from 0 mgs. to 0.87 mg. per 100 ml. with an average of 0.23 mg. per 100 ml. The average ratio of maternal to cord blood Vitamin E levels was 3.4:1.

The birth weight of the infants ranged from 1.0 to 3.9 kgs. with an average of 2.76 kgs. The correlation between birth weight and cord blood Vitamin E levels was 0.033 which was not statistically significant. There was no significant sex difference in cord blood Vitamin E levels. The study of the feeding pattern to be followed by the mothers indicated that a majority wanted to breast feed the baby upto 6 months. Most of the mothers consumed vegetable oils rich in polyunsaturated fatty acids.

Recent work has tended to indicate that the foetal deficiencies, particularly of Vitamin A may be responsible for certain congenital abnormalities. The new born child requires 2000 I.U. of Vitamin A per day, for the growth and liver storage. This necessitates a maternal storage of Vitamin A during pregnancy and lactation What is the exact position of our Indian women with regard to Vitamin A nutritional status? With this question in mind, a cross-sectional study was conducted by Jyothi (1976) at Tirupati on pregnant women to assess the Vitamin A nutritional status at the trimesters in relation to their dietary intake. The women of the sample belonged to low and middle income groups. The effect of supplementation of 24,000 I.U. of Vitamin A per day during the last month of pregnancy on the Vitamin A nutritional status was also undertaken. The subjects selected for this study were clinically normal.

Among the pregnant women, who attended antenatal clinics in Tirupati, seventy one women from low income group and fifty two women from the middle income group were selected such that in each income group, there were a minimum of sixteen women for the three trimesters. Random sampling was used in selecting the subjects for the different trimesters. The age range was 18–30 years and the weights were between 35

and 55 kg. for all these women. The parity was also controlled by setting it to a maximum of three so as to minimise the variable factors. Ten healthy normal non-pregnant women from each of the income groups constituted the control sample. 14 pregnant women of low income group were given 24,000 I.U. of Vitamin A supplement per day in the last month of the third trimester. The Vitamin A in the serum was estimated using the standard fluorometric method. A three day food consumption record for each subject was maintained. From this, daily intake of calories, proteins, fat and Vitamin A was calculated for each of the subjects using food tables. The results obtained are given in table 13.

TABLE — 13

Comparison of the Mean Blood Vitamin A Values of Pregnant Women of Low and Middle Income Groups in the Three Trimesters

S. No.	Sample No.	Period of Pregnancy	Mean blood Vitamin A I.U./100 ml.	't' Value	
		LOW INCOME			
1.	18	First Trimester	36.8±6.99 (26.3—53.3)	0.74	
2.	27	Second ,,	41.5±17.82) (21.0—96.0)		1.82
3.	26	Third ,,	30.3±7.66 (21,0—48.0)	2.50**	
4	10	Non-Pregnant (Control)	34.6±6;74 (26.3—48.0)		
		MIDDLE INCOME			
1.	16	First Trimester	41.0±9.62 (21.0—53.3)	20.8**	
2.	18	Second ,,	50.7±16.88 (32.0—96.0)		1.58
3.	18	Third ,,	36.2±8.22 (21.0—48.0)	3.22**	
4.	10	Non-Pregnant Control	44:5±16.74 (32.0—74.0)		

** Differences significant statistically.

These values are in accordance with the trend observed by other researchers. The fall in Vitamin A in the 3rd trimester could be due to better utilization, hormonal influences and decreased mobilization of Vitamin A from liver.

The mean nutrient composition of the diets consumed by the pregnant women is presented in table–14.

TABLE — 14

The Mean Nutrient Composition of the Diets Consumed by Non-Pregnant and Pregnant Women

S.No.	Period of Pregnancy	Low Income				Middle Income			
		Pro. g	Fat g	Vit. A I.U.	Cal. Kcal	Pro. g	Fat g	Vit. A I.U.	Cal. Kcal
1.	First trimester	35.5	17.0	407	1689	42.8	24.7	488	2075
2.	Second ,,	36.1	17.6	469	1704	44 4	27.8	513	2078
3.	Third ,,	35.1	20.7	491	1765	47.3	24.8	562	2101
4.	Controls	32.4	18.5	438	1744	44 5	29.4	486	2104
5.	Recommended Allowances for Pregnancy	55	—	2475	2500	55	—	2475	2500

The diets of pregnant women were generally deficient in Vitamin A. The women from the low income group particularly consumed nutritionally deficient diets. The diets had very low levels of Vitamin A, calories and protein. The diets of the middle income group women were slightly better, though not satisfactory.

When Vitamin A supplement was given to fourteen women, the mean Vitamin A level rose from 31.5 to 40.2 I.U. per 100 ml. and the difference was statistically very significant. Such supplementation during pregnancy should be extensive in order that the offspring is protected from the hazards of Vitamin A deficiency, which manifests itself as stunted growth and permanent blindness in children throughout India, where dietary deficiencies of Vitamin A are present.

Studies Related to Serum Cholesterol as an Indicator to Malnutrition among the Adult Groups

A different and rarer problem could be one of overfeeding resulting from ingestion of more calories than the sedentary living may warrant for

adult populations. There are some who are characterised by special food fads and attitudes which may cause deleterious effects on their well being.

Malnutrition due to overnourishment is usually a syndrome of affluence. It is largely reported in the more developed countries. The price tag, disease-wise, on overnourishment could be as much as on undernourishment, if not more. The extra servings of the fatty meat, the gravy and the like, steeped in the excellence of culinary conditioning to savour to the gourmet's delight can do enough mischief once down the gullet. Several of the Indian foods could get saturated with fat and carbohydrate. Thus every sedantary man and woman has to be wary about high calorie-foods,.

Consumption of certain nutrients in excess of their requirements contributes to risk from certain maladies. Overnutrition increases the risk of an individual to some specific illnesses like the Cardiovascular diseases, Diabetes Mellitus and others. In many developed countries, Cardiovascular diseases and particularly Atherosclerosis, is the "number one" cause of death and reference is made to this as an 'epidemic of the 20th century'. In India too, the incidence is increasing year by year as has been confirmed by some research findings. The most important and significant factor in atherosclerosis is an elevated concentration of a class of lipids known as cholesterol. It is possible, to estimate the cholesterol level in an individual and to assess the quality of the diet, and get an idea of the risk of future disease i.e. atherosclerosis. With this notion in view, the serum cholesterol concentrations of a sample of men and women between 20 and 50 years were determined in a study by Sujatha (1971) at Tirupati. The subjects were clinically asymptomatic. An attempt was made to relate the cholesterol levels to the age, sex and dietary intake of the subjects.

The sample consisted of 10 men and 10 women in each of the age ranges 20–30, 30–40 and 40–50. They belonged to the upper middle class strata. The data relating to dietary intake was collected through a quantitative record of food consumed for a period of 3 days. From this, the average nutrient intake per day was calculated. On the 4th day the blood samples were collected for the serum cholesterol assay using the Carr and Drekter method (Carr, J.J. and I.J. Drekter (1956) "Simplified rapid technique for the extraction and determination of serum cholesterol without saponification" Clin. Chem: Vol. 2, p 353). The serum cholesterol levels of the group ranged from 101 mg. to 313 mg. per cent. Table 15 gives the mean serum cholesterol levels for the three age groups 20–30, 30–40 and 40–50 years.

TABLE — 15

Serum Cholesterol Levels of Men and Women of Different Age Groups

	Mean Serum Cholesterol levels mgs percent		
	Age Group		
	20–30	30–40	40–50
Men	152.74	189.26	262.70
Women	147.48	234.68	237.50
Average for total group (Men and Women) N = 60	150.11	211.97	250.08

The data presented in table–15 indicates that the sex differences in cholesterol levels were not significant but the differences between the age groups were significant at 0.01 per cent level. Thus an increasing trend in cholesterol levels with age was evident.

The results of the study further pointed out that, when the group was taken as a whole, there was no relationship between serum cholesterol levels and dietary intake. But, when the correlation between serum cholesterol levels and dietary intake of the high serum cholesterol group (beyond 225 mg/100 ml. in the age group 41–50) was calculated, it was found to be significant. The data is given in table 16.

TABLE — 16

Correlations between Serum Cholesterol Levels and Intake of Nutrients of the High Serum Cholesterol Group

Age Group	Correlation of serum cholesterol with			
	Calories	Fat	Carbohydrates	Proteins
31–40	+0.08	+0.059	+0.32*	+0.039
41–50	+0.37*	+0.51*	+0.82*	+0.053

* Significant at one percent level.

The correlations between serum cholesterol levels and calories, fat and carbohydrates were consistently significant for the 41–50 age group while they were not significant for the 31–40 age group except for carbohydrates.

The results of the study indicate that there is an increase of serum cholesterol level with age. Another interesting factor is that in some subjects cholesterol levels were as high as 312 mg per cent and these subjects were clinically asymptomatic. Atherosclerosis is a silent pathological process and suddenly becomes clinically manifest in the form of ischemic heart disease or myocardial infarction. In order to see that it does not end life suddenly, one must take various preventive measures, of which the serum cholesterol control is one. Once the probable cases are diagnosed, appropriate treatment and advice may be given. Since the cholesterol levels correlate with intake of certain nutrients, diet therapy may suitably be applied.

There is a vast literature pertaining to clinical, pathological and animal experimental work to support the epidemiological findings that dietary factors are fundamental to the development of severe atherosclerosis. The development of the disease would appear to be closely associated with the dietary pattern seen in the affluent countries of the world i.e., characterized by a high intake of energy, total fat, saturated fat and cholesterol. In recent years there have been many efforts to reduce the incidence of atherosclerosis. Most of these efforts have involved programmes designed to lower the blood cholesterol levels. A review of literature would reveal a number of interesting observations relating vascular disorders with ascorbic acid. It is apparent that Vitamin C is concerned with the maintenance of normal vascular function and that deficiency of it may cause vascular disease (Ginter, 1974). Hardening of the arteries which leads to heart attacks is a disease caused by Vitamin C deficiency. Vitamin C keeps the arteries clean by preventing deposition of the fatty cholesterol. It also helps in transporting cholesterol from arteries to the liver for conversion into bile acids. It has been suggested that the serum cholesterol could be varied between 140 and 230 mg per cent by increasing the Vitamin C intake or by lowering it respectively. The effects of ascorbate supplementation on the circulating cholesterol levels of man are clouded by controversy. Though a large volume of literature supports the hypothesis, that vitamin C decreases susceptibility to vascular injury, the evidence is not yet conclusive. Lakshmi (1975) and Nirmala (1976) under-took studies to assess the effect of ascorbic acid supplementation on cholesterol levels. The first study was on atherosclerotic patients and the second one was on women college students.

Seventeen patients (11 men and 6 women) clinically diagnosed as atherosclerotic were selected. Ten normal subjects (6 men and 4 women)

matched for age and sex and free from disease constituted the normal control sample. All the subjects were drawn from Tirupati town and the neighbourhood. The age of the subjects ranged from 25 to 45 in the case of women and from 30 to 60 years in the case of men.

Estimation of basal plasma cholesterol and ascorbic acid was done for all the subjects. Then the patients were given 100 mg of ascorbic acid per day for a period of 30 days in the form of "celin" tablets. At the end of this period, estimations of plasma cholesterol and ascorbic acid were done for the patients to assess any change in the levels. During the experimental period of one month, the patients were requested to refrain from taking any other treatment.

Plasma cholesterol levels were estimated using the method developed by Henley (1957) as modified by Chiamori and Henry (1959).[1] Plasma ascorbic acid was estimated by the method of O' Brien et al (1968)[2]. The dietary pattern of the subjects was studied with the help of a questionnaire. From this the average daily intake of various nutrients was calculated.

The initial estimates showed that the plasma cholesterol levels ranged from 144 to 232 mg per cent for normal subjects, while the levels ranged from 221 to 336 mg per cent for the atherosclerotic patients. The final values of cholesterol after intensive ascorbic acid therapy for one month, ranged from 178 to 286 mg percent among the patients. There was a decrease in plasma cholesterol levels in all the patients, the range of reduction being from 3.3 to 34.61 per cent.

The ascorbic acid levels of normals was between 0.84 to 1.5 mg per cent while it ranged from 0.74 to 1.5 mg per cent for the patients. After ascorbic acid supplementation, the levels in patients increased to the range of 1.2 to 2.3 mg per cent thus registering an increase varying between 34 and 112 per cent.

The correlation between percentage decrease of cholesterol and percentage increase in ascorbic acid was 0.35 for men and 0.65 for women, indicating a higher correlation in the case of women than men. Relating the cholesterol levels of patients with their diets it was found that they tended to consume more of cholesterol elevating foods and less of cholesterol lowering foods as compared to the controls.

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1. Determination of total cholesterol by the method of Henley. (1957), modified by Chiamori, N. and R.J, Henry. (1959). Amc. J. Clin. Path, 31. 305. Published in clinical chemistry. Principles and Techniques. A. Hoeber. I.N. (1966)
2. Donough O' Brien, F.A. Ibbott and D.O.Rodgers on *Laboratory manual of Pediatric Micro biochemical techniques.* "Determination of Ascorbic acid in urine and plasma." P. 47–48. 4th edi. Harper and Row, Publishers New York, 1968.

The second study was on the effect of ascorbic acid supplementation on serum cholesterol and plasma ascorbic acid levels of normal women students.

The sample was drawn from S. V. U. Women's hostel residents. Fifty students were selected, of whom, 25 were vegetarians and 25 non-vegetarians. The age of the subjects ranged from 20 to 25 years. First a diet survey of the study sample was undertaken to note down food items consumed over a period of 7 days. At the end of this period the blood samples were drawn for analysis. After this the subjects were given an oral supplement of 100 mg. of ascorbic acid daily for a period of 25 days. At the end of this period once again the blood samples were drawn for analysis. The pre and post levels of ascorbic acid and cholesterol were calculated and changes noted. As the diet during the 25 day period was similar to that noted in the 7 day period prior to the experiment, with each individual acting as her own control, the changes that occurred could generally be attributed to the ascorbic supplementation.

Total cholesterol in serum was estimated by the Carr and Drekter method (1956). To estimate ascorbic acid in plasma, Roe and Kuether method (1948) modified by Mohan Ram (1967) was used.

The results obtained are presented in table 17.

TABLE — 17

Ascorbic Acid Values of College Girls before and after Ascorbic Acid Supplementation

Details	Plasma Ascorbic Acid mg./100 ml.			
	Ascorbic acid supplementation		Difference	Percent increase
	Before	After		
Vegetarians	1.63	1.98	0.35	22.99
N = 25	± 0.33	± 0.28		
Non-Vegetarians	1.35	1.72	0.37	28.90
N = 25	± 0.22	± 0.25		
Total sample	1.49	1.85	0.36	24.17
N = 50	± 0.31	± 0.23		

TABLE — 18

Mean Serum Cholesterol Values of College Girls before and after Ascorbic Acid Supplementation

Serum Cholesterol mg/100 ml.			
Ascorbic acid supplementation		Difference	Percent
Before	After	mg.	reduction
191.5	180.1	11.40	5.84
± 22.09	± 23.09		
219.4	190.2	29 16	12.91
± 25.33	± 29.55		
205 4	185.5	20.40	9.93
± 24.31	± 27.12		

As seen in the table, after ascorbic acid supplementation the serum cholesterol levels decreased and the ascorbic acid levels increased. The decrease and increase respectively was highly significant (-0.52). The correlation co-efficient between percentage decrease of cholesterol and percentage increase of plasma ascorbic acid for the total sample was statistically significant (-0.37). This shows that there is a close relationship between the cholesterol and ascorbic acid levels in blood.

The diet survey indicated a relationship between dietary factors and serum cholesterol levels. The high dietary cholesterol and saturated fats might have been responsible for the higher serum cholesterol level in non-vegetarians as compared to vegetarians. The vitamin C, polyunsaturated fatty acids and fibre were slightly higher in the diets of vegetarians which might have been responsible for the lower serum cholesterol levels among vegetarians. In some subjects the marked reduction of serum cholesterol after a period of 25 days of ascorbic acid supplementation is most encouraging.

Hypercholesterolemia is one of the risk factors for causation of atherosclerosis. By lowering the cholesterol content in the blood, it is possible to control the progress of the disease (Antonio, Gotto and Scott, 1973). Ascorbic acid, although the exact mechanism by which it acts is not known, appears to be a good tool to lower the incidence of Atherosclerosis by decreasing the cholesterol levels in blood The suggested mechanisms where ascorbic acid may be involved are in the conversion of cholesterol to bile acids and their elimination and the utilization of cholesterol in the synthesis of steroid hormones. A dietary regimen containing an abundant supply of ascorbic acid rich foods appears to be a simple method of tackling such a widespread and complex malady like Atherosclerosis. Eating of the fresh fruits rich in ascorbic acid should therefore be encouraged.

The studies reported in the foregoing pages conducted by the students and staff of the department of Home Science, S V. University, give us a glimpse of the extent of malnutrition in the areas in and around Tirupati. Situations in other areas of Rayalaseema may not be very different. Poverty, ignorance and insanitation aggravated by un-helpful natural conditions make the conditions grave.

The national malady of malnutrition afflicting greatly the weaker sections of the population is rampant in some degree or other among all the age groups. The poor rural child to a greater extent and the poor semi-urban child to a lesser extent have been found to be suffering from deficiencies due to low intake of proteins, fats and carbohydrates and thus the total calories, and the other nutrients notably vitamins A and C, iron and the B complex vitamins. Surveys done in other parts of the

country report similar findings. For eg. an ICMR report (Nutrition Atlas of India, 1972) states that the 52 per cent of the poor preschool children have a haemoglobin content less than 10.8 grams per cent. Hanumantha Rao, (1972) reported that 80 per cent of preschool children belonging to the socio-economically poor communities, were suffering from moderate or severe malnutrition. Similarly, Gopalan (1968) had reported that 40 per cent of all deaths in the country are those of pre-school children. Forty per cent of those suffering from protein–calorie malnutrition are those of birth order 1-3 while the remaining 60 per cent are children with birth order 4 and above.

These statistics only go to show that conditions of malnutrition as found in the Tirupati studies reported in this volume are not very different from those reported in several other places (Pereira and Begum, 1974). That malnutrition is widely prevalent among the preschool children of the poorer communities is more than established. What is therefore urgent is that steps to combat malnutrition among the preschool children have to be urgently taken up on a war footing. Most of the preschool children unlike school children cannot come under congregated inspection. As they mostly do not attend schools, they have to be contacted only by a door to door approach. Whatever supplement the child has to receive can only be at home and often through the parents and as such there is always the possibility of the supplement not reaching persons to whom they are intended. Nutritional programmes for the rural preschoolers therefore are fraught with hardships and handicaps.

That parent education for these weaker sections is a laudable scheme on paper but not so in practice, is an oft quoted criticism. The problem of malnutrition among preschoolers is so vast, that efforts of governmental or voluntary agencies at supplementation of feeds could only be a trickle. There has to be greater community consciousness of the malady and its manifestations so as to kindle public interest in the problem. The maternal instinct to safeguard the interests of the child is a strong motivating force that could be cleverly harnessed to buttress the meagre intake of essential nutrients by these children. What could be tried is to feed these children through community kitchens operating for each village or hamlet. Such kitchens have to be run by dedicated people drawn from the village itself and materia requirements should be largely locally sustainable – a sort of a co-operative effort backed by individual motivation and group enterprise.

Malnutrition among school children is not a serious problem to combat. It's existence is easily detectable and there are several well established programmes to raise the nutritional status of these children. With more children coming to school under the compulsory education

scheme, it is possible, by operating through schools to identify cases of various nutritional deficiencies. The mid-day meal programmes and food supplements made available to children in the school should take care, to some extent of gross and severe nutritional disorders. Several cheap foods and nutrients can be made available to children in the school. Certain cereal supplements with ragi, jowar, bajra, maize etc, MPF preparations and periodical concentrated doses of vitamin A can to a large extent, prevent the occurrence of nutritional deficiency disorders. These programmes, instead of completely depending on governmental grants, should also be community supported. The very existence of widespread malnutrition among school children of poor sections indicates that the existing nutrition programmes are either not enough or are ill managed. It is therefore necessary that such programmes be enlarged in scope to cover all school going children, and streamlined to ensure efficient administration. Effective nutritional supplementation definitely has a positive effect on the eradication of nutritional disorders. Last, but not the least, is the urgent need for introduction of nutrition education in the school curriculum. With knowledge of foods and nutrition the school children can make a better selection of foods too. But much before any concrete program that involves the people's participation is launched, it is necessary to make microlevel studies of what people eat and why. Such probes could delve deep into the psycosocial and economic setting in which the food behaviour of a community is cast. Knowledge of the sociometry and communication network of the community, its culture, values and tradition as they affect their eating habits, the extent of possible favourable modification of the local agricultural practices and the feasibility of producing cheap, acceptable and nutritious food locally are the bases on which a sound community nutrition programme is to be built to suit local conditions and needs. Each area or locality must be able to self-sustain its nutrient requirements. It means that an integrated effort has to be launched, to modify the existing eating habits of the people by making acceptable alterations in the foods taken by them such that they would be nutritionally balanced. It should attempt to alter the cropping pattern and agricultural output to cater to, and sustain the food requirements of the region. In essence, what is aimed at is a nutrition programme that would maximise acceptable modifications in foods and eating behaviour that would be nutritionally sound and ecologically sustainable. Attempts at realisation of such objectives have to be borne out of integrated efforts on the economic, agricultural and social fronts.

The ultimate aim of development must surely be the improvement of what is increasingly coming to be known as the "Quality" of life. If the quality of life means anything, it means that human beings everywhere have the food they need to keep them in good health. In the present state of widespread malnutrition, there is tremendous scope for

bold, imaginative schemes by authorities which could bring better food within the reach of the under privileged, at a very small cost compared with the benefits. The improved nutrition, which would save even more lives, especially among young children could help in solving the population problem too. If measures are taken to greatly increase the assurance of survival of, say, the first two children of parents belonging to the poorer segments through better nutrition, the parents would feel much less necessity to have more children, and would accordingly be far more psychologically receptive to the ideas and methods of family planning. Planned families, consequently, will enrich the quality of life and even help the economic growth of the nation.

In conclusion, it is emphasized that community consciousness and involvement by raising the level of the nutritional status of the people of the community has to grow and blossom. Highly individualised approaches characterised by a cynical bystander apathy have to become things of the past. These are things that cannot be achieved in a day or a week, but require sustained effort and devotion. Nevertheless, they are not utopian objectives but well within the reach of a determined people working with a vision.

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Food Consumption Pattern Surveys among Selected Communities of Chittoor District

Introduction

There is no simple procedure for the assessment of nutritional status with regard to a nutrient. Malnutrition is caused more often than not by a deficiency of more than one nutrient with a complex of causative factors. It may result from chronic sub-optimal intakes of one or more of the forty some nutrients needed for health or from an acute deficiency that may be dietary or physiological in origin and even at times related to genetic metabolic errors. The dietary inadequacy may be the result of low socio-economic status characterised by illiteracy, food fads and fallacies.

The methodology for the assessment of nutritional status is varied. It includes clinical diagnosis, anthropometric measurements, biochemical and biophysical evaluations and dietary surveys (Jelliffe, 1967). The choice of method or methods will depend on the type of malnutrition suspected and the thoroughness with which the state of malnutrition must be assessed, apart from the size of the sample. When dealing with large populations the assessment of nutritional status is usually broad and covers many several deficiency states. Studies with small populations can be more intensive.

Dietary surveys are considered to be a necessary tool for basic research in nutrition. These are of practical value both in developing and evaluating community nutrition programmes These surveys indicate the areas where emphasis should be given. Dietary surveys reveal desirable practices that should be encouraged and perpetuated and undesirable practices due to prejudices of cultural, and religious origin, which must be curtailed. Changes in attitudes in relation to food practices should be brought about.

The idea that qualitative intake of food can tell one approximately the nutritive value of the diet is the basis for surveys, which assess the nutritive value of the diet by approximate guides as, the Basic Four, Basic Five or Basic Seven Foods. However, food intakes can be measured with due emphasis on the quantity as well as quality of foods. There are various types of diet surveys, which assess the quantitative intake of foods as given below – (Usha and Devadas. 1964).

Diet Surveys

Family or Institutional surveys	Individual surveys
1. Checking the stock by inventory	1. Oral questionnaire.
2. Weighing of raw foods.	2. Weighing of cooked food before consumption.
3. Checking the food lists	3. Recording by using household measures.

The method followed depends on the type of evaluation to be made.

The following paper covers the dietary surveys done among communities in and around Tirupati. The surveys indicate how food habits and consumption patterns affect the health and nutritional status of different selected groups of people.

SECTION - A

Factors Affecting Food Habits and the Nutritional Status of Communities :

As is well known food consumption is largely influenced by food habits. Food habits are deeply significant and important in the every day life of most people (Burgess and Dean, 1962). Food habits are defined as the way in which an individual, or groups of individuals in response to the social and cultural pressures, select, consume and utilise portions of the food supply (Guthe. and Mead, 1943).

Food habits are also influenced by income, culture, industrialisation and urbanisation, education, tradition, attitude and religion, family system, caste system, national security and defence, prestige status and last but not the least the woman who is the decision maker in the home (Devadoss - 1968).

Kamakshamma (1969) undertook a study of the factors affecting the food habits of the rural people living in three villages of Chittoor District in Andhra Pradesh, and another study was done by Uma Maheswari (1970) on factors affecting food habits of employees in Sri Venkateswara University, Tirupati. In addition, the effect of these food habits on the nutritional status of children (2.5 to 7.5 years) and lactating mothers was assessed.

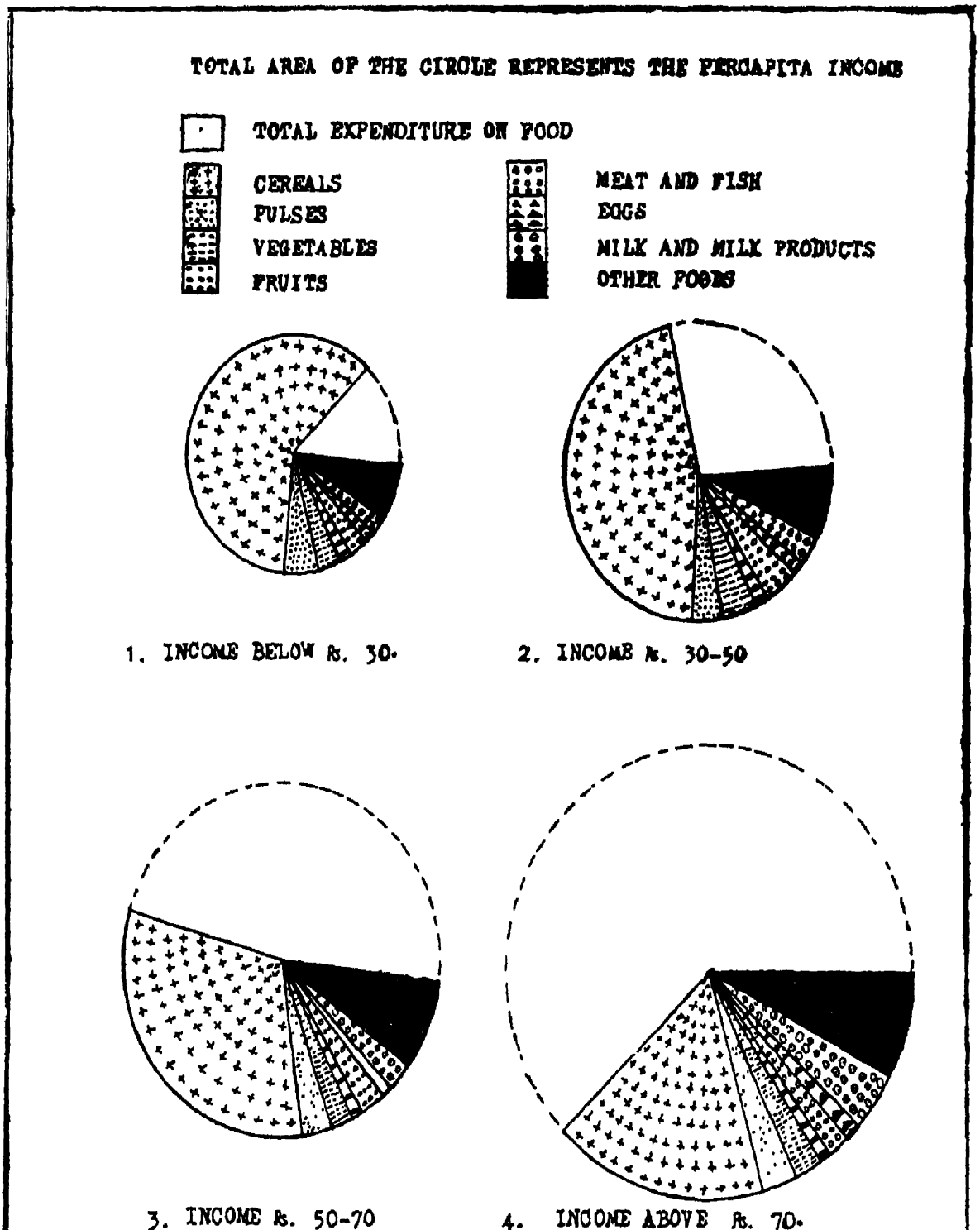


FIGURE 1: MEAN PERCAPITA INCOME AND EXPENDITURE PATTERN ON DIFFERENT FOODS AMONG COMMUNITIES OF THREE VILLAGES OF CHITTOOR DISTRICT.

The subjects selected for the studies were rural and urban families respectively. Randomly selected and statistically valid samples were taken so that every family had the same chance of being selected for the study. A total of 308 families were selected from the three villages in the first study whereas about 104 families were selected for the second study. Questionnaire schedules were prepared for collecting information on general background of the family with stress on food practices, food fads and prejudices, food habits in relation to religion, special conditions and customary feeding practices of infants and children.

The value of these two studies lies in cross comparing the factors influencing food habits among rural and urban populations. The second study, gives further information as to how far these food habits have an impact on the nutritional status of children and lactating mothers in particular.

Analysis of variance technique was used to find out significant differences on food expenditure pattern between (1) income (2) occupational groups. Coefficient of correlation was done between per capita income and expenditure in the first study, between per capita expenditure on food, heights and weights of children and lactating mothers in the second study.

Data on food fads and fallacies were pooled and presented as such and food consumption patterns were noted in frequency tables. Results are presented under specific headings relating food consumption pattern to different factors which influence food intake.

1. *Food – Income and Occupational Status :* Differences in expenditures on food among different income groups and among different occupational groups were observed. Figure 1. illustrates the differences observed in the choice of foods from a low income to the rising income groups among the rural families.

As the income level improved, the total per cent expenditure on food decreased. There is a positive correlation for the income and expenditure pattern on foods such as vegetables, pulses, fruits, eggs, meat, fish and milk, milk products with the exception of cereals. The consumption of cereals however decreased with increasing income.

The poor man consumes food for calories. Cereals yield more calories in relation to a given sum of money than milk, meat etc. Hence the cereal consumption is high among the low income groups. Aykroyd (1961) states that enough food is a primary human need. When people are poor they must rely on cheaper foods to obtain sufficient calories. These statements support the present findings.

Among the higher income groups, quality foods like milk, eggs, meat, vegetables, are consumed to a greater degree than in the low income groups. Aykroyd (1968) has pointed out this fact that the range of income plays an important part in determining the food choice.

With regard to occupation, the land owners, were classified under the high income group and the labourers under the low income group with others occupying the intermediary levels. The choice of foods was evidently better among the families of land owners than among those of labourers.

In the study among families of the urban area, as the high income group consisting of readers, lecturers and assistant lecturers of the S.V. University had similar expenditure pattern for foods. The choice of foods was generally varied and adequate in quanity. In the low income group, however consisting of attenders and sweepers, the expenditure on foods was low though most of the total income was directed to food expenditure. The nutritional status of the latter group was below standard as a result of limitations in choice of food and in the quantities consumed.

Comparing the rural and urban setting, it is evident that in both cases level of income is a deciding factor for the quantity and quality of foods selected.

2. *Food-Beliefs and Taboos:* People belonging to lower socio-economic group are found to have more taboos and superstitious beliefs regarding food than those of the upper socio economic groups. Hence they tend to avoid some foods completely though they are within their purchasing power. From the present studies, a few examples of such beliefs and the foods avoided are selected and presented in table no. 1.

TABLE — 1

Lists of Foods avoided as per Taboos and Superstitious Beliefs

S.No.	Foods		
	A. Heat Producing	B. Cold Producing	C. Flatulence causing
1.	Drumstick leaves	Bottle gourd	Potatoes
2.	Amaranth	Ridge gourd	Yam
3.	Cluster beans	Snake gourd	Ladies fingers
4.	Ladies fingers	Cucumber	Green chillies
5.	Brinjal	Radish	Bengal gram
6.	Papaya	Tomatoes	Jowar
7.	Bengal gram dhal	Sweet Limes	Eggs
8.	Horse gram		
9.	Bajra		
10.	Eggs		
11.	Goat meat		
12	Jaggery		

Religion has its own role on choice of foods sometimes advantageously and yet at other times adversely. It was observed that festivals help to add nourishment even to the diets of poor income families.

3. Food – Prestige and Status: The following attitudes and practices were observed among rural and urban families. Ragi is labelled as the poor man's food. Hence the upper income groups avoid it while the lower income groups welcome it. For coffee consumption, the reverse is true, the richer classes consuming more of it than the poorer classes of people. Breakfast items such as Idli and Dosai are consumed by the upper income groups while left over cooked rice soaked overnight is often the poor man's breakfast. Prestige and status therefore determine the choice of foods.

4. Food – Social and Emotional Aspects: In the villages surveyed, the possibility of all family members sitting together and eating is not there and hence they do not share their emotions and the food to make the meal time a happy rendezvous for the family. Sometimes, though it is possible it is not customary for the female members to eat along with the male members of the family. Thus, little consideration and importance are given to the emotional and dietary needs of the women. Children also fall in this category as they tend to eat with the mothers. Although the meal time is generally not an occasion for family get together, the meal pattern is fairly regular for all with three main meals a day.

The value given to the male members as the bread winners of the family leads to serving them the best items of the diet in large quantities at the expense of the other members of the family. This practice adversly affects the vulnerable groups of women and children particularly among the low income groups with regard to their nutrition and health status.

5. *Food Habits and Practices of Special Groups:*

a) *Dietary practices of pregnant and lactating women:* The diets of pregnant and lactating women are restricted in quality and quantity by their age old beliefs and by insisting on a strict dietary regimen. The need for additional nutrients during pregnancy is, hardly realised in the villages. The following table illustrates the beliefs regarding foods during pregnancy and lactation.

TABLE — 2

Food Beliefs During Pregnancy and Lactation

	Food Belief	Reason Expressed
1.	Eggs should not be eaten during the later half of pregnancy.	Causes abortion, child will be born with bald head.

	Food Belief	Reason Expressed
2.	Papaya should not be eaten.	Causes abortion.
3.	Coconut or coconut water should not be taken.	Child will be born with a bald head.
4.	Root vegetables, specially potato and bengal gram should not be eaten.	Causes flatulence and discomfort.
5.	Eggs should not be eaten by lactating mother.	New born gets fever and health is affected.
6.	Curds and fruits should not be consumed till the 3rd or 4th month after delivery.	Child will get cold and fever.
7.	Whole grams and pulses should not be eaten upto one month after delivery.	Child's digestive system gets affected, resulting in diarrhoeas.

Parvathi Rao (1968) and Rajalakshmi (1969) reported similar beliefs held among rural women in Telengana and other areas. Thus the pregnant women, who should consume extra nutrients for their increased requirements actually consume less nutrients due to the beliefs held in the villages.

b) Feeding Practices of Children : Jelliffe (1967) indicates that breast feeding alone for 4–6 months is the cheapest, cleanest, most easily digestible and available source of protein. After the first 4 to 6 months breast milk is never nutritionally adequate and the child always requires additional foods as well He further emphasizes that by the first birth day the child's diet should include all items of the adult diet. Chillies and hot spices should however, be avoided. In the villages the infants are breast fed and no supplements are given until 9 to 12 months because the villagers feel that the infant does not need anything extra apart from the mother's milk. They also fear, that, the infant cannot digest any external food fed. Solien and Scrimshaw (1957) reported that, the concept of special food needs for the health of young children is almost non existant In Guatemalan villages. For other Indian villages Parvathi Rao (1968) reported the same belief. It appears then that the need for special foods for young children is not realised among rural people of the developing countries across the world.

6. Food – Effects of special habits : Majority of men and women above 40 years in the villages surveyed, are found to chew betel leaves, nuts and tobbaco. They reported that they can forgo their meals but not this habit. Chewing betel directly or indirectly affects the food intake of the people. The formation of this habit may be due to the fact that it helps them in withstanding hunger caused by inadequate food intake of the malnourished groups. Women generally consume more chunnam or lime along with the betel leaves, which might reduce the calcium hunger of the body to some extent.

From the results of the two surveys in the rural areas and in semi urban areas it is seen that irrespective of the area the prominent factors adversely influencing food habits are economic, social, cultural and relegious in origin. Urbanisation and education are found to reduce the intensity of the effects of these factors on food intake.

7. Food habits and their effect on the nutritional status of children and lactating mothers : The second part of the study by Uma Maheswari (1970) on dietary habits and their effects on the Nutritional status of children between 2.5 to 7.5 years and on the lactating mothers, showed a good correlation between the two factors. The nutritional status of children was assessed by noting down –

(1) Actual food consumption (one day weighment method) ;
(2) Anthropometric measurements (height and weight) and
(3) Clinical survey (observation of physical appearance).

For this Nutritional Survey, a schedule recommended by ICMR for the clinical nutritional survey by the 'Rapid Method' was used.

Results indicated a high correlation between nutrient intake, nutritional status and income. There was a high degree of malnutrition among low-income groups. The percentage of children, who were malnourished and below 'Normal' decreased however, with a rise in income. These observations are in agreement with the points made in an International seminar on Problems of Nutrition in Developing Countries (1965). It was pointed out at the seminar that, children of low socio economic class are generally deficient in many nutrients.

The height and weight curves of both girls and boys in the upper socio economic group were at a higher level than those of the lower and middle socio-economic groups. This was because the former class got better quality foods, had fewer food fads and beliefs than the latter class of people. Education and also urbanisation among the upper income groups reduce food fads and beliefs. The results showed that when the heriditary character is recessive the height increases with the consumption

of good diets. This is in agreement with Rajalakshmi's (1969) statement that, growth of the body as well as height depend to a larger extent on dietary intake during the growth period although heridity also plays a role.

The weights of the lactating mothers showed a similar relationship between income and nutritional status. This is again an impact of food habits and intakes, which change with varying income levels, the food intake of the upper income groups being better than that of the lower income groups.

These survey studies confirm that, food habits, which are governed by economic status, superstitious beliefs, traditions, educational level and urbanization, have a very strong bearing on the health of the community irrespective of rural or urban populations. Such surveys on food habits and food consumption help one to plan out both short and long term programmes to overcome malnutrition as well as superstitious beliefs about foods. Nutrition and health education, feeding demonstrations and supplementary feeding programmes are some of the programmes visualised either to prevent malnutrition or to cure the condition. The approaches taken should be repeated and continuous to change age old food habits and beliefs. Improving the income of the families is the basic step to improving the food intake in quantity and quality and thereby the nutritional status. The results of the studies discussed indicate that as the income level goes up the food intake as well as nutritional status improve among the women, children and among families in general. Hence efforts should be directed toward raising family income.

SECTION B

Survey of the dietary intake and food habits among individuals of different age groups living in institutions (Hostels and old age homes) :

Studies conducted by Ambica Gopal (1965), Indubala (1965) and Sujatha (1974) on the diets provided at different institutions are reported here.

The first study compared the nutritive adequacy of the vegetarian and non-vegetarian diets consumed by adult women in Sri Venkateswara University Women's Hostels - Tirupati. The second study was a survey among adult men consuming vegetarian and non vegetarian diets in the Men's Hostels of Sri Venkateswara University with special reference to nutrient intake allowing for plate loss. In the third study the food habits, nutrient intakes and clinical status of old people (60–80 years) were assessed. A comparison was made of institutionalized and non-institutionalized old people selected from Madras City and Chittoor District.

These studies were conducted with two main objectives. One objective was to assess the nutritive value of the diets consumed by the young men and women in hostels and by old men and women in the old age homes and the implications on the nutritional status of the individuals. The second objective was to suggest to the managements ways and means of improving diets of these individuals.

The Indian council of medical research conducted a number of surveys in the districts of Andhra Pradesh, yet these were only family surveys. Limited information is available on the diets consumed by particular age groups in institutions like student hostels and old age homes, where, not only the types of foods available but also the management of food procurements and mode of preparation play a significant role in the dietary intake.

Lifquist (1952) pointed out that, providing good meals in institutions is just imaginary. Yet, with good management this can be achieved. Diets in institutions can be more easily corrected by nutrition workers than the diets of individual families as the population in the former group is under control. Most of the difficulties encountered in sampling of family surveys do not arise in institutional surveys. It is feasible to investigate the food intake in a refined and more accurate way in institutional survey whereas it is highly difficult and time consuming in a family survey (ICMR – 1951).

Selection of Subjects for the Study : The subjects selected in the first two studies were representative of the total population of students living in the hostels and were as follows :

A hundred and three women consisting of 61 vegetarians and 42 non-vegetarians from the S.V.U. Women's Hostel, and a total of 24 men students from the S.V.U. Men's Hostels were selected. Eight members each were selected from the one vegetarian and two non-vegetarian sections from the different men's hostel blocks. The number of subjects for the second study was limited as plate waste had to be recorded in each case in addition to food intake.

The selection of subjects for the non institutionalized old people was done from among the people living in the Municipal area of Tirupati. The institutionalized were selected from the "Home for the Aged" at Chittoor and from "The Friend in need Society" and the home of "Little Sisters of the Poor" at Madras. There are no old age homes in the vicinity of Tirupati. Hence, Madras and Chittoor were selected. The age range was 60 to 80 years in all the situations studied. On the whole 84 institutionalized individuals were selected, 12, 32 and 40 from the Home for the Aged, Friend in Need Society and Little sisters

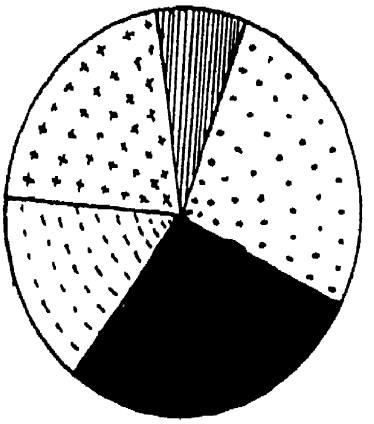
of the Poor respectively. For the non-institutionalized a 100 individuals were selected, 56 men and 44 women from among families living in Tirupati.

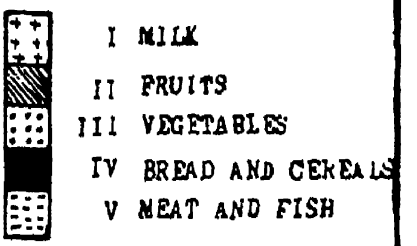
In all the three studies the subjects were medically examined for height, weight and clinical status to determine the basal nutritional status. Dietary survey was conducted by the weighment method. In the study on men conducted by Indubala the plate waste was also recorded by weight for each individual. In both the hostels 10 days in a month and 3 days in a week were randomly selected for collection of food. The analysis was carried out for certain nutrients – protein, vitamin C, iron, calcium, carotene and calories on pooled homogenised samples of the cooked food. Standard methods were followed. The results of these surveys indicate the following pattern.

1. Food Habits : Institutional food selection, preparation and service differ from that of family food selection, preparation and service. In a family the mother knows the preferences and attitudes of family members in accepting the food prepared and therefore she selects and prepares suitable foods. In institutions, it is not feasible to cater to every one's likes and dislikes. Foods are selected and prepared as per contract supply. Hence there can be more plate loss in institutions, till the individuals get habituated to the foods, which they were not used to at home. Study on plate loss can thus give an indication of the food habits of the individual students and that of the families.

The plate loss study conducted in the Men's hostels indicated that food was not much left over during breakfast time. This may be because the students are quite hungry early in the morning. Maximum plate loss was observed during dinner, which can probably be due to the boys having some extra snacks outside the hostel in the evening. The tendency of the boys was to waste vegetables and hence there was more plate waste during midday meal and dinner time than during breakfast time where vegetables were not served.

Students were not having any kind of organisation and restrictions on food service. They served more than what they wanted and hence though variety and quantity was available they did not make the best use of it and tended to waste. Willson et al (1968) reported that, college men in the western countries did not waste food served while the college women were more fussy about food. In this study unlike in the west, plate waste was high and consisted mostly of vegetables, in Men's hostels. This might be one reason why an ascorbic acid lack in the diet was observed. Also, there was less inclusion of fruits and vegetables in the diets provided at all the hostels leading to low ascorbic acid intake Students waste particular vegetables like tomato, potato, drumstick and kovai Hence their diet tended to be generally low in





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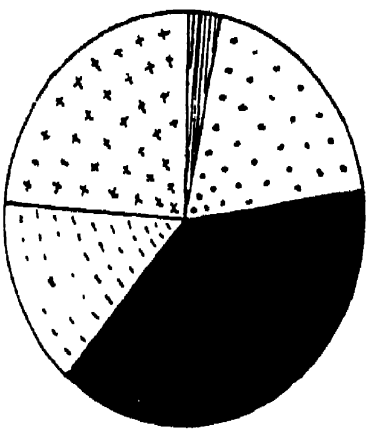
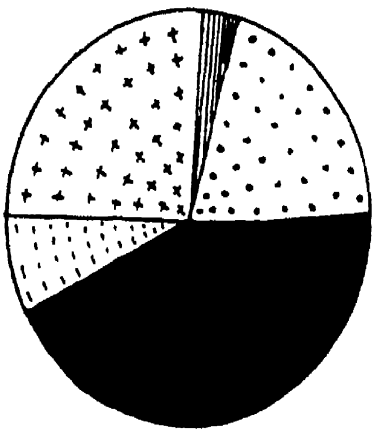


NON-VEGETARIAN



VEGETARIAN

FIGURE 2: A COMPARISON OF RECOMMENDED BASIC FIVE FOODS WITH THOSE CONSUMED BY VEGETARIANS AND NON-VEGETARIANS OF SRI VENKATESWARA UNIVERSITY WOMEN'S HOSTELS.

intakes of vitamin C and iron. Lady students tended to select and eat free choice foods in a limited way unlike the men.

2. *Food fads and beliefs:* Vegetables such as drumstick, brinjal, root vegetables, papaya and others are avoided by young and old alike with the belief that some are heat producing and some are cold producing while some others cause flatulence. Fried foods, nuts and oil seeds, and mutton are reported to cause indigestion.

Hard and brittle foods were generally avoided by the older group of people may be, because of weak dentures and difficulty in chewing as was observed by Ruth (1973) among the older people.

Food fads and beliefs are found more among the non institutionalized old people than among the institutionalized ones. None of the institutionalized old people refused, avoided or wasted foods. They had to eat whatever was given. The non-institutionalized people however are at home and are more attention seeking from family members by way of exhibiting fads and prejudices, which are some traits of old age, the second stage of childhood.

3. *Food consumption pattern and nutrient intake of people in different institutions:* The results indicate that the vegetarian and non-vegetarian diets of the ladies hostels of S.V. University and also those of the S V. University Men's hostels, provided the required amount of calories and proteins for adult men and women engaged in moderate activity. A large proportion of the calories supplied by the diets in the ladies hostels was from carbohydrate rich foods like cereals and tubers. Figure No. 2 illustrates that the consumption of cereals is more than the recommended allowances for this food group. The same situation applied to Men's hostels. This is a characteristic feature of almost all diets in the developing countries. Though the absolute needs for protein and calories were satisfied, the protein calorie ratio for vegetarians and non-vegetarians were 6.7 and 6.9 per cent respectively. This is below that of the standard value of 11 per cent suggested by Vandonk (1964). Under these conditions whether the proteins were effectively available to the body or not cannot be stated.

The intake of iron and ascorbic acid were inadequate in the case of men living in the hostels. This might have been due to the low consumption of vegetables and also because citrus fruits, and leafy vegetables were provided in limited amounts at the time of the survey. The drastic cooking methods followed such as frying might also account for the low intake of vitamin C among the hostelites.

In the case of ladies, the intakes of iron and vitamin C as from the diets were significantly below that of the recommended allowances. Furthermore all the iron supplied by the diets might not have been

available to the body. An excess of phosphorous and phytin in the diet may complex with inorganic iron and may prevent its absorption into the body. Considering the above factors that affect iron utilization the analysed iron intakes cannot be an indication of the actual amount of the nutrient absorbed into the body. Hence the iron nutritional status of the ladies may be worse than what is reported in this study.

The calcium intake was adequate for the students in the vegetarian and non-vegetarian sections of the men's hostels. This mineral intake was a little above the requirement levels for women, in the ladies hostels. The higher intakes in the ladies hostel may be due to their regular consumption of milk and milk products as shown in the figure 2.

The carotene intake of the students (ladies and gents) was far below the requirement levels under Indian conditions. When the carotene intake was compared with that of the recommended allowances for Holland (Men and Women), which was the only country that expressed requirements as carotene (Beaton and McHenry – 1964), again the values were far below western standards. A comparison of the vegetarian and non-vegetarian sections of the hostels showed that for the non-vegetarian sections addition of tomatoes to egg curry twice within the 10 days of the dietary survey, increased the carotene content of the diet. The selection of carotene rich foods occasionally, contributed to the intake. However, a regular organised choice of foods is indicated to be necessary in the management of food supplies to the hostels.

In general, a comparison of the diets provided at vegetarian and non-vegetarian sections indicate that the non-vegetarian sections provide slightly better diets than the vegetarian sections. This may be because of the extra non-vegetarian items provided for the non-vegetarians with no suitable substitute foods for the vegetarians.

The dietary pattern for the aged indicates, that, the consumption patterns of food are not much different among the high and midddle income groups of the non-institutionalised old people. However, the old people of the low income groups had a poor dietary pattern. The frequency of consumption of prestigious foods like wheat and root vegetables, was high in the high and middle income groups whereas the poor man's foods like bajra and ragi were completely avoided by these groups (Rajammal Devadoss – 1968). The frequency of consumption of pulses showed a decline with an increase in income. So income has an effect on the consumption pattern of pulses even among old age people. Green leafy vegetables were consumed weekly twice by all the families of high and middle income whereas these are consumed thrice in the low income groups. If greens are not cooked with care they lose their attractive green colour and become mushy. This might be one important reason why people of high and middle income groups do not accept

greens preparation frequently in their diets. Roots and tubers are consumed much in high income groups whereas it is low in the low income group who believe that these vegetables cause flatulence, in addition to their prohibitive cost (Rajalashmi, 1969). People in general are not very particular to eat fruits daily and the consumption depends on seasonal availability. This indifference is mainly due to ignorance about the importance of fruits in the diet and also due to the high cost (Rajammal Devadoss, 1968).

Milk and milk products were consumed among all income families but they varied in quantity and quality depending on income levels. The low income groups were particularly interested in consuming different beverages and this may be because they prevent them from hunger.

Meat and meat products though they are liked by all income groups, the high and middle income families in general ate only once a week and the low income group rarely because of the prohibitive cost.

Fats and oil consumption is common to all income groups. However, it is a matter of quantity and quality with reference to income level.

Consumption of sugar is common to all income groups specially since everybody, uses it either in coffee or in tea. Consumption of sweets is rare in the low income families.

The data on food consumption patterns are in consonance with the findings of Bovit (1963) and Rajammal Devadoss (1968) who concluded that non-availability of foods and low purchasing power of people are the major contributory factors for the inadequacy of the diets among people.

In all the institutions for the aged, foods are served depending on the availability and cost. Food expenditure in such institution is entirely dependent either on charity or on government aid. Hence, in welfare institutions such as the old age homes cost and availability of foods seem to be the crux of the problem.

As far as the liking for the special foods is concerned sweets are liked most. This may be because the taste sensitivity to sweets will be higher in old people as the sensitivity to other tastes decreases with age (Amerine at al 1961).

The nutrient intake of the aged people from the above food consumption pattern is presented in Table No. 3. Among the non-institutionalized old people a declining trend was observed in all nutrients consumed between the age ranges 60–70 and 70–80 years irrespective of sex and income level.

TABLE — 3

Average Daily Nutrient Consumption among Non-Institutionalised Elderly Men and Women in Relation to Age and Income Levels

Income	Age	Sex	Calories	Proteins (g)	Calcium (mg)	Iron (mg)	Vitamin A I.U.	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
High	60–70	Males	1424	30.12	0.46	12.21	1824	1.18	1.04	6.70	41 70
	60–70	Females	1284	27.23	0.24	10.33	1846	0.95	0 86	5.62	30.90
	70–80	Males	1370	26.85	0.33	11.43	1507	0.54	0.61	6.63	33.25
	70–80	Females	1163	25.47	0.38	10.81	1811	0 53	0.54	5 81	29.81
Middle	60–70	Males	1334	26.57	0.42	11.15	1579	0.76	0.73	5.75	37.90
	60–70	Females	1287	25.37	0.35	11.58	1483	0.54	0.80	6.17	24.40
	70–80	Males	1279	25.18	0.30	10.40	1535	0.71	0.53	6.48	20.96
	70–80	Females	1167	25.24	0.31	10.68	1546	0.57	0.49	5 35	29.51
Low	60–70	Males	1196	17.35	0.31	8.71	1203	0.79	0.76	4.78	13.61
	60–70	Females	1033	11.20	0.18	7.83	1102	0.53	0.42	4.12	14.41
	70–80	Males	1123	18.55	0.29	9.21	1082	0.50	0.50	5.03	12.35
	70–80	Females	1005	11.03	0.21	7.33	897	0.55	0.50	4.66	11.03

The females consumed a lower level of nutrients than males at all income levels. As the income level declined the nutrient intake also declined. However, there was a sharp decline in nutrient intake from the middle to the low income groups. When a comparison was made between the intake of nutrients with that of the recommended allowances, lower intakes were observed for most nutrients except for calcium. Even this mineral intake was low in the poor income group.

Among the institutionalized elderly, the protein and calcium intake was higher than that observed among the noninstitutionalized group (Table No 4). The range of protein intake was 30.80 to 50.53 g. in the former group while it was only 11.03 to 30.12 g. in the latter. The calcium intake was 0.26 to 1.02 g and 0.18 to 0.46 g. for the institutionalized and noninstitutionalized respectively. Not much difference was evident for all other nutrients in general. The inmates of the home for the aged at Chittoor had a markedly higher intake of iron, vitamin A and ascorbic acid than any of the others.

TABLE — 4

Average Daily Nutrient Consumption among the Institutionalized Elderly Men and Women

S. No.	Institution	Sex	Calories	Protein (g)	Calcium (mg)	Iron (mg)	Vitamin A I.U.	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
1.	Little Sisters of the Poor	Males	1472	50.53	1.02	13.18	773	0.65	0.95	5.40	6.26
		Females	1154	42.70	0.88	9.09	538	0.53	0.80	4.45	4.00
2.	Friend in Need Society*	Males / Females	1012	30.80	0.86	7.50	725	0.56	0.54	4.50	4.50
3.	Home for the Aged, Chittoor	Females	1347	32.60	0.26	25.45	2509	0.97	0.72	7.42	18.50

* Food served was limited and the same amount was given for both men and women.

On the whole, when a comparison is made between the institutionalized and the non-institutionalized groups of old people in some aspects the diets of the institutionalized are much better than those of the non-institutionalized. For example in the home of the little sisters of the poor the old people were given milk powder, which was supplied through foreign aid. This food improved the protein, calcium and riboflavin intake of the aged in the institution. In the Home for the aged at Chittoor, the intake of iron, vitamin A and ascorbic acid was far better than in the non-institutionalized groups.

Poverty and ignorance play a major role for lesser nutrient intakes in the low income groups (Rajammal Devadoss, 1968). Among the high income groups, low nutrient intake may be due to a lack of appetite resulting from either a reduction in the taste buds or a decreased sense of smell. Psychological reasons also play a major role among the aged of the high income families, in the intake of foods (Ruth 1973).

4. Effect of nutrient intake on the nutritional status of institutionalized individuals : As already indicated, dietary surveys, anthropometric and clinical surveys are important aspects in evaluating the nutritional status of the individual or population groups. These complement and supplement each other in assessing the nutrient deficiencies prevalent.

Marked signs of nutrient deficiencies were absent among all the students living in the hostels as per the physicians reports on the general examination of the subjects. This might be interpreted to mean that the subjects might have got adopted to the existing nutrient intake which was not adequate with regard to many of the nutrients studied though it was with regard to some. A better absorption and utilisation of nutrients is suggested among the individuals studied. For example the data obtained with regard to the men students in the hostels indicated that the haemoglobin values of the subjects are generally near normal from 12.8 to 13.5 g. per 100 ml. as compared to the standard value of 14 g. per 100 ml. However, it was observed that intake of iron was not adequate among these people. This only suggests some type of biological adaptation to the environment of low iron intake.

Clinical examinations of blood pressure and pulse rate indicated normalcy in all subjects. The results of faecal and urinary examinations also showed no abnormal conditions. The anthropometric data on height and weight indicated that all subjects consuming vegetarian diets had lower measurements as compared to the standard values for the particular age group. This indicates that, the non-vegetarians are generally better nourished that the vegetarians among the students staying in hostels.

Clinical assessment of the aged revealed that 80 to 100 per cent of the old people suffer from cataract, 100 per cent from dental caries, 25 to 50 per cent from pyorrhoea and related diseases of the gums, about 80 per cent from oedema 80 to 100 per cent from body pains. Outward symptoms of nutritional deficiencies were not frank but a minor percentage showed Angular Stomatitis, bleeding gums and the like.

Irrespective of the income and institutionalization or non-institutionalization, almost an equal percentage had disorders like, constipation (30–50 per cent) and indigestion (8–16 per cent). In the low income groups however, the old people were generally undernourished, hypertensive (40–63 per cent) and had heart diseases (8–30 per cent) and Diabetes (7–10 per cent). A high legel of blood pressure and heart diseases are reported more among the women, both in the institutions and in the non-institutionalized state. All these diseases seem to be common to old age, which might be due to the decreased cell function and impaired metabolism resulting in changes in structure and function of the various organs, with advancing age.

These diseases involve degenerative changes of old age which result in death and are inevitable. But, the onset of the diseases might be delayed by sound nutrition from infancy to the old age. Cultivation of good food habits and avoidance of food fads and beliefs and release of emotional stress by good recreational facilities can help to promote good food intake and better nutritional status of the individuals.

The diets in all the institutions as assessed by the three studies reported here indicate, that, they can be improved to a great extent just by supplementing some foods, which are rich in essential nutrients. The non-vegetarian sections of the hostels need to be supplemented with cheap and easily available leafy vegetables and fruits as the intake of iron and ascorbic acid in these individuals is low. In addition, other common vegetables in large quantities should also form part of the daily diet. Cheap sources of fruits like papaya, mango and tomato are recommended. Germinated grams can be included as cheap and best sources of both protein and ascorbic acid Pulses and nuts specially groundnuts are cheap sources of protein and B-vitamins and are recommended. Use of millets other than rice such as bajra and ragi along with the habitual rice consumption, would improve calcium and iron intake of all the groups studied.

Conclusions :

In a situation of advancing food shortage, time consuming detailed investigations (like the biochemical analysis of populations), prior to action programmes may be wasteful and unacceptable to administrative bodies. Crude rapid estimates of nutritional status may be required

and advantageous. Once the action is initiated a more intensive survey can be done. Survey data of the nature, discussed here are of vital importance in planning nutrition programmes, monitoring effectiveness of the programmes and for evaluation of existing programmes.

The primary environmental influences on nutritional status are dietary intake and the incidence of disease. Other factors of economic, social and cultural origin necessarily exert their effect through either the dietary intake or the disease pattern.

Nutritional and health care of institutionalized and non-institutionalized populations based on quick surveys are vital for the welfare of the community.

Institutional studies of the nature reported here indicate that the nutritional and health status of the young men and women in hostels and of the aged in old age homes need to be improved. This could be done by creating proper awareness about the nutritional value of foods both among the management personnel and among the inmates of the institutions and by a wise choice of and expenditure on the available foods, which are nutritionally adequate.

While nutrition action programmes can be more effectively implemented in institutions through the management, which controls a population more closely, the non-institutionalized people pose difficulties with regard to management. Their choice of foods is based more on available money, food fads and beliefs and status consciousness. No authority guides their actions. Such a set up can only be controlled by education on the concept of nutrition for the particular group and on the nutritive value of foods.

Among the poor income groups, the primary concern should be to raise their economic level in order to increase the purchasing power for better foods. Nutrition education among these groups can be effective only if income is raised by some means.

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Nutritive Value of some Processed Protein Sources from Plant and Animal Kingdom

Introduction

Mankind at this critical period of our history, is faced with a serious threat to its existence as the food production seems to be falling short of the ever increasing demands by the galloping populations. Some of the major problems needing immediate attention as stated by Kanwar (1974) are –

(1) The widening gap between the production of food and the exponential increase of population;

(2) A greater percentage of population falling below the age of 15 years, increasing the demand for more proteins of high biological value;

(3) Shrinking resources of land available per capita for food production and

(4) Imbalanced nutrition as exemplified by shortage of proteins and also fats.

Food is not only falling short quantitatively but, its imbalanced nature and poor quality are causing a serious problem. It is assuming a more alarming dimension among vulnerable groups of children and also among the poor sections of the community in the developing countries. A look at the food patterns of the world shows that western nations derive their proteins primarily from animal sources, whereas in the developing countries like India the main sources of proteins are of vegetable origin and cereals provide the bulk of it. The remaining protein comes from other grains and legumes. Hence, the research programmes in India have been directed not only at increasing the total production of cereals and pulses per unit area cultivated but also at upgrading the protein content genitically. Searching for new protein sources with good quality and increasing the biological value of food by home processing procedures have been followed. Several studies have been done on evaluating the quality of new protein sources.

In this context a few research projects were undertaken in the Department of Home Science, S.V. University, TIRUPATI on three major aspects.

1. Biological evaluation of Fish protein concentrates (FPC) ;
2. Biological evaluation of Leaf protein concentrates (LPC), and
3. Biological evaluation of germinated beans, grams and peas.

Weanling albino rats were used in each of the above projects for evaluating the biological quality of the protein sources. Growth, digestibility and biological value studies were done.

SECTION — A

Biological Evaluation of Fish Protein Concentrates

Of the 510 million square kilometers of the surface of the globe 361 million square kilometers are covered by the ocean. Of this, 206 million square kilometers area is in the Southern Hemisphere. Only a comparatively small part of this vast ocean is being exploited for fisheries. One of the oldest industries on earth is fishing. Increased interest is being shown in this industry since the beginning of the 20th century and increased world fishing yields are reported. In the last decade the growth of fisheries has been greater than that of many other food industries. In the developing countries, where there is a high population explosion, the people are experiencing food shortage and the world as a whole will have to find food for double its present population by the end of this century or shortly afterwards (Scrimshaw, 1969) The green revolution of the recent years though it has brought about considerable optimism yet the yield does not contain sufficient concentration of protein for young children. Hence it will be difficult to provide protein in quantity and quality from the plant kingdom, to meet the needs of the vulnerable groups. Conventional animal protein foods such as Milk, Meat and Eggs are beyond the purchasing power of much of the world's population. Hence unconventional protein foods have been explored as possible sources of protein. Proteins have been concentrated from green vegetation, Algae, Years and from single cells grown on petroleum fractions. However, the incorporation of these proteins in human diets is met with grave problems of acceptance by the consumers. Marine fish proteins offer a promising future among the conventional foods used for production of protein concentrates (Rods 1969).

Fish protein concentrates are prepared from fish, which are available in very large quantity and which are either not acceptable for direct human consumption or, are consumble but susceptible to rapid spoilage. Fish protein concentrates (FPC) have several advantages. They are bland, odourless, stable and non-toxic products, which are suitable for feeding even infants and pre-shool children. They are a cheaper protein source than market fish. The protein quality of several cereal foods has also been shown to increase when fish protein concentrate

is supplemented (Morrison et al 1960). Fish proteins can be introduced into the existing diets as they are acceptable to the consumer. Proper marketting channels need to be opened up to make the fish products available to the needy consumers.

The studies presented here on fish protein concentrates, were done by Nirmala (1970) and Ally Kutty Mathews (1971). The first author studied the biological value of protein from Silver Bellies, its supplementary value to rice and its general acceptability in indigenous recipes. The second author assessed the biological value of protein concentrate from miscellaneous fish (a mixture of 6 varieties), its supplementary value to rice and its general acceptability in indigenous recipes.

General Experimental Procedures

The experiments were carried out on weanling albino rats weighing 32 to 38 grms. In the biological value experiments, the animals were fed the proteins at a 10 per cent level using a standard protein for comparison at isonitrogenous levels. The supplementary value of the fish proteins to rice based diets was also assessed using the albino rats. The fish proteins were substituted to rice in a basal diet containing rice, to provide 10, 20, 30, 40 and 50 per cent of total nitrogen of the basal diet. The total protein content of all the diets was around 7 per cent. The acceptability of fish protein concentrates was tested by incorporating the proteins into several recipes and serving these to a trained taste panel as against a standard recipe. The introduction of the FPC into the recipes was in the range of 2.5 to 12.5 grams and did not exceed 12.5 g. per 100 g. of cereal, pulse or vegetable used in a recipe.

In both these studies the reference protein source used was purified casein. The protein content of all the protein sources was estimated by the standard microkjeldahl method (AOAC, 1965). The protein concentration was estimated to be 85.86, 87.50 and 8 25 per cent in the first experiment and 82.13, 90.50 and 7.35 per cent in the second experiment for the casein, fish protein concentrate and rice respectively.

In all the animal studies on fish protein concentrates, for the selection of animals and distribution under different treatments, similar considerations were given. An adlibitum feeding regime was followed. Daily food consumption records were kept. The animals were weighed initially and weekly twice thereafter. The experimental period lasted for 3 weeks for the study of biological value of proteins. For the supplementary value studies, 4 weeks were allowed. In the 3 week experiments, during the first and third weeks, the animals were kept on the respective protein diets and during the second week, all the rats were allowed to

feed on a non-protein diet. During the non-protein period (see fig. 3 period 'a', endogenous faecal and urinary nitrogen excretion was measured for calculating the biological value of the proteins after correction for endogenous losses. Nitrogen balance study was carried out during the third week when the respective proteins were fed (See fig. 3 period 'b'). An adjustment period of 3 days was allowed before the 4 day urinary and faecal collections were done in any treatment. Nitrogen analysis was done on the 4 day pooled samples of urine and faeces for individual animals. Diets were also analysed for nitrogen to obtain nitrogen intake.

Biological value (B.V.) was calculated from the analysed nitrogen values of diet, faecal and urinary samples using the following formula (Venkata Rao et al – 1968)

$$\text{B.V.} = \frac{\text{Food Nitrogen retained}}{\text{Food Nitrogen absorbed}} \times 100$$

The protein efficiency ratios for the different proteins were calculated from the weight gain both in the first and in the third weeks wherein the proteins were administered. The values were then compared between the first and third week for each of the proteins and between the different proteins for each of the weeks of experiment. Protein efficiency ratios were also calculated in the studies where the supplementary feeding value to rice was tested.

Results – Pattern of weight gain of animals fed fish protein concentrates and standard casein

In the study on biological value of Silver Bellies, the weight changes during the protein and non-protein periods are shown in figure 3. This was the pattern observed for both the fish protein concentrates studied. During the first week of feeding C asein and FPC, the weight gained is almost equal and there is no significant difference between the two proteins. But, during the third week in both the studies, it is observed that the weight gain is much greater than in the first week for the standard casein as well as for the fish protein. Moreover fish proteins induced a better growth than casein. The greater weight gain recorded during the third week is probably due to the greater sensitivity of the animals to protein feeding after a period of protein deprivation. This type of response was observed even when leaf proteins were tested for their biological value (See section B).

Protein efficiency ratios of fish proteins and standard casein

The protein efficiency ratio of the FPC from Siver Bellies or from Miscellaneous fish when compared with that of Casein showed that the

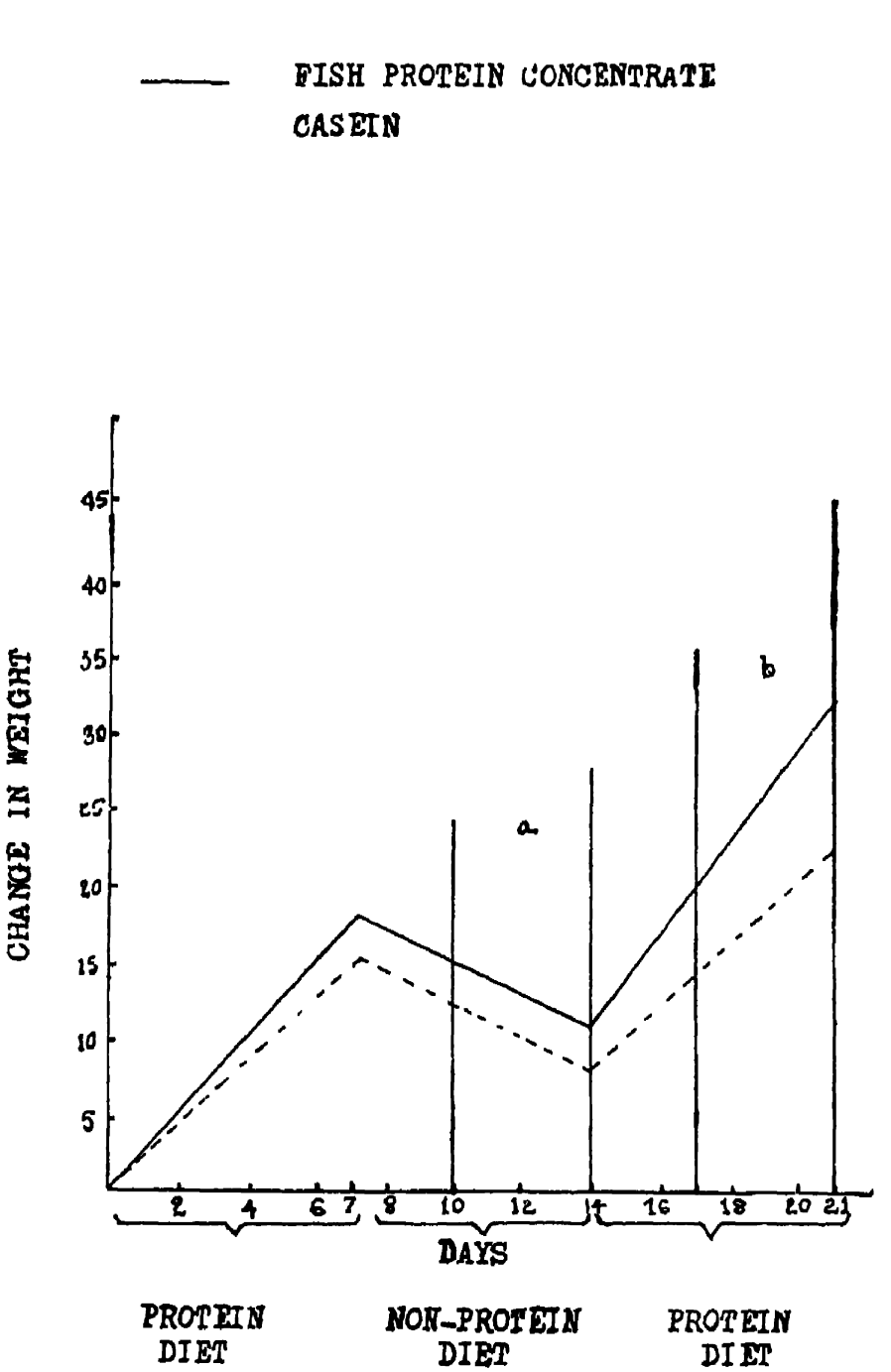

FIGURE 3: WEIGHT CHANGE OF WEANLING ALBINO RATS FED CASEIN AND FISH PROTEIN CONCENTRATE DURING ALTERNATE PROTEIN PERIODS.

PER is higher in the thirdweek as compared to that in the first week for all the proteins tested and that the fish proteins are far superior to casein in promoting growth. This latter trend was particularly pronounced during the third week of the experiment. With FPC from Silver Bellies the PER values are 3.50 and 4.05 for the first and third weeks respectively. For Casein the values are 2.81 and 3.5 for the first and third weeks respectively The PER of Miscellaneous fish protein is 2.90 and 4.0, of Casein 3.1 and 3.8 during the first and third weeks respectively. Shurpalekar et al (1962) reported a PER of 2.92 for Sardine fish and 3 04 for skimmed milk powder. In the present study the FPC indicated a higher PER values than that reported by Shurpalekar et al, particularly in the third week of the experiment. This difference in observations may be due to the difference in the methodology of the two experiments in that the animals fed FPC from Silver Bellies and Miscellaneous fish were put into a state of protein deprivation prior to feeding the proteins in the third week whereas the animals in Shurpalekar's experiment were not so deprived and therefore less responsive to the fish proteins fed. A difference in fish varieties may also account for the difference in PER. The results reported by Desai et al (1968) on fish proteins are generally in agreements with the present results.

Biological value of fish protein concentrates and standard casein

Regarding the biological value of the fiish protein concentrates, it is found that the B.V. of the FPC is definitely superior to that of casein. The B.V. of casein and FPC in the first study where FPC from Silver Bellies was fed, is 88.26 and 92.48 respectively. For the second study where animals were given FPC from Miscellaneous fish, the B.V is 82.64 and 90.91 for casein and FPC respectively. The difference in B.V. is statistically significant at 1 and 5 per cent level in the study with Silver Bellies FPC and at 1 per cent level in the study with Miscellaneous FPC.

Digestibility coefficients of fish proteins and standard casein

When the true digestibility values are studied, casein is found to be digested slightly better than FPC, though the PER and B.V. are higher for the latter compared to the former. The digestibility values ranged from 92.30 to 93.15 for casein and from 89.00 to 90.91 for FPC. Despite the differences observed, fish proteins can be classed as well digestble proteins Munro and Allison (1964) compared the biological value of several animal and plant proteins and placed FPC next to egg protein. The results of the present study support the observation made by Munro and Allison.

Liver protein utilization of fish protein and casein fed animals

Another criterion by which the quality of the proteins was assessed is Liver Protein Utilization (LPU). This method was proposed by Mo-

kady et al (1969) and is based on liver nitrogen assessment in control and experimental groups of animals. The formula is as follows :

$$LPU = \frac{(L - LC)}{I} \times 100$$

Where L = Liver nitrogen content (g) of experimental animal.

LC = Liver nitrogen content (g) of control rat with the same initial weight after 10 days of non protein diet feeding.

I = Nitrogen (g) consumed by the experimental animal.

LPU results again supported the PER and B.V. results. The values are 22.45 and 26.88 for Casein and Silver Bellies FPC, 27 17 and 37.47 for Casein and Miscellaneous FPC respectively in the first and second experiments. Liver is a tissue which reflects dietary protein quality. Hence assessing its nitrogen content is a good method for evaluating protein quality. LPU values based on liver nitrogen analysis can be relied upon for grading protein quality. It can be concluded from all the criteria measured in the present studies that fish proteins have a high nutritive value.

Mutual supplimentary value of fish protein concentrates to rice diets when incorporated at various nitrogen levels

The supplementary effect of fish proteins to a rice diet was assessed by protein efficiency ratio and liver nitrogen evaluations. As already indicated under general procedures, the FPC was incorporated at 10, 20, 30, 40 and 50 per cent of total nitrogen in the basal diet for both varieties of fish proteins. All the diets were isonitrogenous.

Results are presented in Table No. I. A steady increase in growth (weight gain) from that of the basal is observed from one level of supplementation to another over a four week experimental period with the growth levelling off at 40 and 50 per cent levels of nitrogen incorporation from the fish proteins. Best growth is observed at the 50 per cent incorporation of both kinds of FPC into the rice diet. The growth of animals fed casein at the same nitrogen level was less than that observed at all levels of fish protein supplementation. PER values indicated the same trend as weight gain. While the rats fed with 50 per cent FPC show a PER of 3.24 for Silver Bellies, for Miscellaneous fish protein it is 3.7. A study by Smith and Kenny (1969) also showed an increased nitrogen efficiency with the incorporation of FPC into a corn diet. Liver nitrogen values also show a progressive increase with increasing levels of fish protein nitrogen either from Silver Bellies or from Miscellaneous fish.

TABLE — 1

Protein Efficiency Ratio and Liver Nitrogen Values obtained on supplementation of Fish Proteins to Rice Diets, at Various Levels of Nitrogen

Experiment No.	Variety of FPC	Criteria	Rice Diet	Levels of nitrogen supplementation					Casein standard
				10%	20%	30%	40%	50%	
1.	Silver Bellies	PER	1.63	1.94	2.52	2.58	3.19	3.24	1.86
		Percent liver nitrogen	8.71	9.57	9.64	9.62	10.25	10.67	9.60
2.	Miscellaneous Fish	PER	2.30	2.90	3.10	3.60	3.80	3.70	3.00
		Percent liver nitrogen	8.39	8.95	9.65	10.22	10.36	10.50	10.03
3.	White Sardines	PER	2.30	2.64	2.82	2.93	3.06	2.81	2.84
		Percent liver nitrogen	6.34	6.89	7.45	7.70	8.06	7.92	7.59

Subsequent to the two studies reported, in a third study Jhansi Lakshmi (1972) investigated the biological value of FPC from White Sardine and its supplementary value to a rice diet. The experimental procedures were identical as in the previous two experiments. A 10 per cent protein level was tested. Results indicated B.V. of 87 per cent for White Sardine FPC and 85.62 per cent for casein. The PER values were 3.92 and 3.47 for the FPC and casein respectively during the 3rd week of the experiment. The true digestibility of casein was higher (94.40) as compared to that of White Sardine (86.00). LPU values were 30.82 and 28.76 for casein and FPC respectively. When the White Sardine was incorporated into a rice diet at 10, 20, 30, 40 and 50 per cent of total nitrogen, a progressive increase in growth and PER was observed with increasing amounts of the FPC and at 50 per cent level, the growth declined. The results are presented in Table – 1 along with per cent liver nitrogen values. The per cent liver nitrogen values also follow the growth trends.

Several other studies show similar increase in growth on feeding various fiish proteins to rice, maize and other cereal diets. With better quality proteins, the level of nitrogen intake increases and a marked effect on protein efficiency ratios occurs. The good quality of FPC when supplemented to rice might be due to its high lysine content, which the

cereals lack. Hence it is very apt to propagate the use of fish protein concentrates in areas where rice is the staple food and where the intake of protein rich foods is meagre. Fish flour could be produced in greater quantities for easy availability either as bland flavoured products or as slightly fish flavoured ones to suit the customs and habits of the people in the region. This approach benefits specially the vulnerable groups of the population by offering a good nutritious food at a reasonably low cost.

The quality of the proteins can be assessed in relation to body functions such as growth or nitrogen balance. PER is based on growth and B.V. is based on nitrogen balance. Of these two parameters biological value is more accepted and a reliable method as it is an estimate of the absorbed nitrogen retained from dietary proteins consumed. PER is however, based on an overall weight gain per gram of protein intake. Weight gain may not always be due to protein retention only. Water and fat content, can contribute to tissue weight. Hence B.V. is preferred to PER.

In all studies reported here fish proteins from Silver Bellies, Miscellaneous fish and White Sardine have been found to have a high nutritive value as per the biological value measured. In fact they have been found to be even better than the milk protein casein. Since the reliable method of biological value has been followed for evaluating these proteins, it can be concluded that fish proteins are valuable for true growth of the young ones of a species. They can thus be recommended for the nutrition of weaned infants and children.

The general acceptability studies of the fish protein concentrates were done by introducing the proteins into indigenous recipes and subjecting them to taste panel evalution. The main objective of this part of the study was to assess, the eatable quality of recipes, which have been improved in protein quality by the introduction of the fish proteins. The recipes were standardised with different levels of FPC as shown in the table No. 2.

TABLE — 2

Levels of Fish Protein Concentrate Incorporation into Indigenous Recipes

Fish Protein incorporated	Name of the recipe	Levels of FPC (g per 100 g)				
		Standard	1	2	3	4
1	2	3	4	5	6	7
Miscellaneous FPC	1. Biscuits	0	2.5	5.0	...	...
	2. Banana Bread	0	2.5	5.0	...	...
	3. Samosa	0	2.5	5.0	10.0	...
	4. Potato Cutlet	0	2.5	5.0	10.0	...
	5. Vegetable chapati	0	2.5	5.0	10.0	...

1	2	3	4	5	6	7
	1. Vadai	0	2.5	5.0	10.0	12.5
Silver	2. Uppuma	0	2.5	5.0	10.0	...
Bellies	3. Tamarind rice	0	2.5	5.0	10.0	12.5
FPC	4. Emli Uppuma	0	2 5	5.0	10.0	12.5

In some of the recipes, the higher levels of FPC were not tried as the fish flavour was marked at these levels. All the recipes tried out were well accepted by the panel members with regard to colour, flavour and texture at different levels of FPC incorporated.

Vijayalakshmi (1971) found White Sardine FPC also acceptable in various indigenous recipes such as Pakodas, Biscuits and Diamond cuts. These recipes can therefore be applied in snack and supplementary feeding programmes for children as also in adult diets.

SECTION — B

Biological Evaluation of Leaf Protein Concentrates

Green leafy vegetation, which is as such inedible is a potential source of protein for human consumption. With the advances in Food Science and Technology, efficient methods of extracting protein from different plant sources have been worked out. Food proteins have been obtained from seeds and nuts for the past several years. Green leaves of different species of plants have been explored as sources of protein and found to yield considerable amounts of the nutrient.

Leaf proteins were prepared about two centuries ago and its resemblence to casein was noted 30 years ago. The possibility of using it as human food was recognised eighteen years ago (Pirie, 1958). The bulk separation of leaf proteins has been started. These proteins need to be popularised for human consumption.

Experimental studies conducted in the past showed that leaf protein concentrates are generally deficient in methionine and other amino acids and that supplementation of these amino acids increases the nutritive value of the protein. Hence interest arose to assess the comparative nutritive value of different leaf protein concentrates, produced at the Central Food Technological Research Institute, Mysore. Three studies were conducted during the years 1967–'69 in the department of Home Science, S.V. University.

Premalatha (1967) undertook the study of the effect of supplementation of limiting amino acids, Leucine, Methionine and Lysine to Lucerne leaf protein concentrate on the growth promoting value for the weanling albino rats Sharada (1968) worked further on the biological value of Lucerne leaf protein concentrate when supplemented with the limiting amino acids. Casein was used as the reference protein. Rajalakshmi (1969) studied the true digestibility coefficient, biological value and net utilization of proteins from different leaf protein concentrates as compared to those of casein and Lucerne in weanling albino rats. The leaf proteins were from Beetroot, Knolkhol, Turnip, Carrot and Cauliflower.

The general experimental procedures were the same as used for the evaluation of FPC (Section–A). The growth experiments lasted for 4 weeks and the biological value studies for 3 weeks. Since the evaluation of proteins by biological value has been extensively done and found sensitive to protein quality it was chosen even in the studies with leaf proteins. A 10 per cent protein level was tested in all cases. Adlibitum feeding was done. The per cent protein content of the different leaf proteins ranged from 26.04 for Carrot to 51.45 for Lucerne.

Nutritive value of Lucerne protein

The results are presented in Table 3. The weight gain of animals fed supplemental amino acids to Lucerne was markedly greater than that of the animals fed only Lucerne protein. Casein gave the best growth as assessed either by weight gain or by Protein Efficiency Ratio. The quality of leaf protein improved with the supplementation of the limiting amino acids and the animals ate more food and grew better than those given only the deficient Lucerne.

TABLE — 3

Mean Data Related to Weight Gain, Protein Intake and Protein Efficiency Ratio of Weanling Rats fed Lucerne Protein and Casein Over a four Week Experimental Period.

Sl. No.	Diet	Weight gain (g)	Food intake (g)	Protein intake (g)	Per
1.	Basal diet Lucerne Protein.	38.3	196	19.6	1.94
2.	Basal diet + Leucine + Lysine + Methionine.	61.3	221	22.1	2.78
3.	Reference Casein Protein.	77.7	246	24.6	3.15

Similar results were obtained by Singh (1968) with Lucerne Protein Concentrate fed at a 10 per cent level, when the protein was supplemented with Methionine and Lysine.

The biological values of 61.61, 72 31 and 81.68 were obtained for Lucerne Protein alone, Lucerne plus limiting amino acids and casein respectively. A significant positive correlation was found between weight gain and biological value. Casein was better digested and absorbed than the leaf protein, the values being 94.5 and 78.2 per cent respectively. Such a trend has been observed in human infants. Waterlow (1961) observed 79.1 per cent absorption of leaf protein nitrogen in convalescing infants which was lower than that obtained for milk (90.5 per cent).

Individual amino acid supplementation to Lucerne protein showed that methionine was the most limiting amino acid among Leucine, Lysine and Methionine tested When Leucine and Lysine alone were given, there was a mild amino acid imbalance indicated by a lowered food intake, growth depression and a mild lipid accumulation in the livers This was corrected by methionine supplementation. Harper (1964) reported depressed food intake, decreased nitrogen balance and growth in amino acid imbalanced states, which can be quite severe. In the present study only mild imbalance effects occured. This may be due to the controlled low supplementation of Leucine and Lysine to the Lucerne protein. The imbalance may be intensified by an increased supplementation of these amino acids.

Twenty per cent liver fat was recorded in rats fed a 10 per cent leaf protein diet. Harper (1953) reported 25 to 35 per cent liver fat in 9 per cent casein fed rats. This shows that both the proteins are lacking in methionine. On supplementation of methionine, the liver fat decreased to 13 8 per cent in the present study. Harper (1953) reported a similar finding by supplementing methionine to casein, when liver fat decreased.

Nutritive value of other leaf protein concentrates

In experiments for the evaluation of the biological value of the different leaf proteins Rajalakshmi (1969), found that all the leaf proteins tested had a lower digestibility, biological value and net utilisation of protein compared to those of casein with one exception. The results are presented in Table–4. Carrot LPC had a higher biological value than casein though its digestibility and NUP were poor. The leaf proteins could be arranged in the following order as per the biological value – Carrot, Cauliflower, Turnip, Lucerne, Knolkhol and Beetroot. The

digestibility of all the leaf proteins was lower than that of casein. It is known that the fiber of plant tissue is not well digested in the monogastric animals and this fiber has an influence against the digestibility of the proteins (Maynard, 1962). The present results support this contention.

TABLE — 4

Biological Value, Digestibility and Net Utilization of different Leaf Proteins compared to those of Casein

S. No.	Protein Fed	Biological value	True Digestibility	Net Utilization of protein
1.	Casein	86.96	95.92	83 44
2.	Lucerne	70.73	83.47	58.99
3.	Beetroot	49.79	71.93	35.84
4.	Knolkhol	65.50	73.16	50.87
5.	Turnip	74.08	67.60	50.13
6.	Carrot	92.81	28.38	26.38
7.	Cauliflower	84.35	79.05	66.71

In all these studies with leaf proteins, when biological value was estimated after a week of non–protein feeding (to obtain endogenous excretion of nitrogen), the growth response of the animals during the protein refeeding was much more pronounced than that observed during the intitial period prior to the nonprotein diet feeding. For example the mean weight gain of the animals for Lucerne protein during the first week was 6.9 grams while it was 13.4 grams during the third week after one week of nonprotein feeding. For cauliflower, it was 10.6 and 21 4 grams during the first and third weeks respectively. It appears then that growth promoting value of the protein is dependent on the physiological state of the animal. It has been observed by Munro (1964) that the biological value of a protein is not fixed but depends on the physiological state of the experimental animal. From these observations one can conclude that proteins can be best evaluated for their nutritive value after subjecting the animals to a period of protein deprivation, when they become extremely sensitive to any protein feeding.

SECTION — C

Biological Evaluation of Germinated Beans and Pulses :

Pulses and Beans are common items of Indian diets. They are consumed either whole or as dhal or germinated. Germinated pulses are consumed both in the raw and cooked states (Devadatta et al 1951). Whole grams and dhals are consumed mostly as cooked products.

The great vatue of germination and fermentation in culinary practice is from the facts that they make the food more digestible, appetising and of high nutritive value. Several studies have indicated nutrient changes and enrichment on germination of pulses (Aykroyd 1964, Deshmukh 1966, Meyer 1963, Neelaveni 1968). However, several authors have shown that the ascorbic acid content of germinated foods is lost to different degrees by different methods of cooking.

Two studies done at the department of Home Science, S.V.U. College have shown that the Moth Bean (Phaseolus Aconitifolius) on germination, improves in total ascorbic acid content and undergoes changes in the nitrogenous constituents. The effect of further cooking the germinated bean by different methods on the nutrient content has also been investigated. Neelaveni (1968) observed a rise in ascorbic acid content of Moth bean from 7.83 mg percent at 12 hours of soaking to 99.12 at 36 hours of germination. After that period, the ascorbic acid content declined. The protein nitrogen declined from 2.58 grams per cent (12 hours soaking) to 2.24, 1.02 and 0.51 at 24, 48 and 72 hours of germination. The non protein nitrogen increased from 0.29 grams per cent (12 hrs soaking) to 0.41, 1.07 and 1.25 at 24, 48 and 72 hours of germination. It was suggested that Moth Bean protein may be more available to the body on germination as the protein is converted to soluble nitrogenous constituents. Chandralekha (1969) subjected the 36 hour germinated moth bean to 4 different methods of cooking i.e., pressure cooking, steaming, boiling and frying and estimated the total ascorbic acid losses. The results are presented in Table 5.

Between the different methods of cooking the mean ascorbic acid content of the Moth bean was different. The highest percentage loss occured in frying and the lowest percentage loss occured in pressure cooking.

TABLE — 5

Effect of Four Different Methods of Cooking on the Total Ascorbic Acid Content of 36 Hour Germinated Moth Beans.

Sl. No.	Method of Cooking	Ascorbic Acid Values In raw Germinated mg/100g. of dry	Ascorbic Acid Values In raw Germinated mg/100g. of fresh	In cooked germinated	Loss during cooking	Percent loss during cooking
1	2	3	4	5	6	7
1.	Pressure cooking	105.01 ± 3.25	25.85 ± 3.29	18.63 ± 2.35	7.22 ± 0.84	27.97 ± 0.49

1	2	3	4	5	6	7
2.	Steaming	104 47 ± 3.33	27.66 ± 4 22	18.80 ± 2.98	8.86 ± 1.20	32 12 ± 0.53
3.	Boiling	103 30 ± 0.99	31 52 ± 3.34	19.83 ± 2.47	11.70 ± 0.88	37.15 ± 1.05
4.	Frying	103.77 ± 2.20	26.27 ± 2.78	12.67 ± 2.30	13 82 ± 2.47	52.62 ± 0.12

When the differences in the loss of ascorbic acid between the different methods of cooking were analysed statistically a highly significant difference was found between frying and each of the other three methods of cooking. Between the other three methods the differences were not statistically significant.

Germination initiates and enhances ascorbic acid synthesis in the pulses (Chatopadhyaya and Banerjee (1952), Meyer and Mayber (1963). But yet ascorbic acid loss is reported to occur due to (a) the water soluble nature of the vitamin, (b) the alkaline medium during cooking, (c) ascorbic oxidase enzyme in the food (Pai – 1958). The results of the present study support the reasons put forth for the loss of ascorbic acid on cooking. The highest loss occured on frying and the minimal loss occured on pressure cooking For frying a high temperature and open vessel cooking are required where oxidation of the vitamin can occur to the highest degree. Pressure cooking on the other hand is done in a closed vessel for a shorter time, atmospheric oxygen being less and retention of the vitamins being more (Pasricha 1967). Hence pressure cooking appeared to be the best method of cooking for greater retention of ascorbic acid in germinated moth bean. Steaming and boiling also gave a fairly good retention of the vitamin and can be recommended as good cooking methods for germinated pulses. Wherever possible consumption of the germinated moth bean as such without further cooking should be encouraged as this would provide the most nutrients to the body.

While it is necessary to know the nutritive value of pulses in raw germinated and cooked states, by chemical analysis, the ultimate test for the nutrient quality is by biological availability studies. It has been shown that the proteins of pulses and beans undergo a change during germination in that the insoluble high molecular weight proteins are converted to soluble low molecular weight amino acids as assessed by the protein nitrogen and nonprotein nitrogen content of the foods. The value of germinated beans and pulses for the growth of the weanling

albino rats and the digestibility of the nitrogenous constituents of the same were studied by three different workers in the department of Home Science, S.V. University College.

Chandralekha (1969) evaluated the nutritive value of germinated Moth bean by digestibility and growth studies in weanling albino rats. Baby (1970) evaluated the nutritive value of germinated greengram and cowpea by digestibility and growth studies in weanling albino rats. Sudha Devi (1971) evaluated the nutritive value of germinated red gram and bengal gram by digestibility and growth studies in weanling albino rats.

In all these experiments the experimental procedures were alike. Weanling albino rats from the same stock colony were used. Experimental period was for 4 weeks. Basal diet composition was the same. The pulses were fed at isonitrogenous levels (10 per cent protein level) as non–germinated and as germinated for 12, 24 and 48 hours with casein as the reference protein. Feeding was adlibitum. Criteria for evaluation of the nutritive quality were digestibility, protein efficiency ratio and per cent liver nitrogen. The results are presented in Table 6 in the order of the experiments done. All pulses improved progressively in their nutritive value as germination period increased as per the criteria of digestibility, protein efficiency ratio and per cent liver nitrogen measured. At 48 hours of germination the maximum values were obtained for all and they were fairly comparable to those of the milk protein casein. Bengal gram however, had the highest nutritive value at 48 hours of germination as compared to the other pulses, the protein efficiency ratio and percent liver nitrogen being even more than that of the standard protein casein. The values were 3 33 and 11.05 as against 3 07 and 10.99 for casein. Thus it is observed that germination in general improves the availability and utility of the protein of the pulses for various functions of metabolism in the animal. Similar observations were made by Kamble and Sohonie (1968) in rats fed sprouted and non–sprouted grams at a 10 per cent protein level in diet. On germination the nutritive value of the grams improved significantly. Viswanath and De (1951) observed a greater availability of amino acids in germinated soya bean as against that of the raw bean.

Percent liver nitrogen measurment is a better criterion than protein efficiency ratio as the former is known to respond clearly to the quality and quantity of protein fed (Venkat Rao et al - 1963). Body weight gain is not always an indication of protein quality as Munro et al (1964) have observed that body weight gain may include changes in other body constituents such as fat and moisture apart from protein changes. Protein efficiency ratio based on body weight gain may not therefore always precisely indicate protein quality. In the present studies per cent

TABLE — 6

Nutritive Value of Beans and Pulses germinated for a varying Period and fed to Weanling Albino Rats

S. No.	Treatment	Percent Digestibility	Protein Efficiency Ratio	Percent Liver Nitrogen
		Moth Bean		
1.	Non germinated	74.5	1.66	7.30
2.	12 hours germinated	82.9	1.84	7.65
3.	24 hours germinated	84.2	2 10	8.27
4.	48 hours germinated	91.6	2.58	9.89
5.	Casein – standard	97 1	3.22	10.94
		Green Gram		
1.	Non germinated	78.6	0.96	8.99
2.	12 hours germinated	82.4	1.19	8.59
3.	24 hours germinated	82 8	1.17	9.29
4.	48 hours germinated	90.8	2.19	10.23
5.	Casein – standard	96.6	2 64	11.00
		Cow Pea		
1.	Non germinated	78.6	1.32	...
2.	12 hours germinated	83.1	1.59	...
3.	24 hours germinated	86 1	1.91	...
4.	48 hours germinated	91.4	2.99	...
5.	Casein – standard	97.5	3.28	...
		Red gram		
1.	Non germinated	83.3	1.35	8 40
2.	12 hours germinated	87.6	0.82	11.00
3.	24 hours germinated	88.6	0.99	11.40
4.	48 hours germinated	89.8	2.02	12.20
5.	Casein – standard	95.6	3 09	12.80
		Bengal gram		
1.	Non germinated	83.7	2.52	10.62
2.	12 hours germinated	85.4	2.78	10.76
3.	24 hours germinated	87.2	2.88	10.91
4.	48 hours germinated	91.6	3.33	11.05
5.	Casein – standard	97.4	3 07	10.99

liver nitrogen values have shown that protein quality improves on germination of the Moth bean as well as the other pulses. A positive correlation was observed between protein efficiency ratio and liver nitrogen

values for all the pulses studied which indicates that the body weight gain was due to a deposition of protein as per the quality of nitrogen sources provided in the diet.

Some other studies done in this department (Neelaveni 1968 and Sudha 1971) have shown that the non protein nitrogen of moth bean, red gram and benga[1] gram increased progressively as the time of germination is increased. However, at 48 hours of germination there was a marked increase in soluble nitrogen. It appears that the significant growth promoting value of the beans and pulses observed at 48 hours of germination is in some way related to the significant change in nonprotein nitrogen (NPN). This is interpreted, not by a mere hydrolysis of proteins to amino acids in the germinating seed since per unit nitrogen intake the amount of each of the amino acids consumed should essentially remain the same and the growth then would not have changed significantly from that of the non-germinating seed. There may be an increased availability of the amino acids as also an increase in the concentration of particular amino acids. Deshmukh and Sohoni (1966) observed that as germination progressed in greengram the concentration of Methionine per unit weight of the protein fraction did not alter to any significant degree but the concentration of Methionine in the N.P.N. fraction at 48 hours of germination almost doubled from that seen in the 24 hours germinated fraction. The amino acid increased from 1.5 mg. to 2.9 mg. per 100 grams of the seed. Many of the other amino acids (essential and non-essential) also increased in concentration in the NPN fractions at 48 hours of germination. Excess amino acids may also decrease in concentration on germination and give a balanced mixture. Red gram for example gave a PER and per cent liver nitrogen value of 1.35 and 8.40 respectively in the nongerminated state. At 48 hours of germination the corresponding values were 2.02 and 12.20, which is a considerable improvement from the basal level. It has been suggested that the high phenylalanine content of non germinated red gram (490 mg as against 338 mg for casein) may be lowered in the 48 hours germinated gram along with changes in concentration of other amino acids thus leading to a more balanced mixture of the amino acids for rat growth. A study of the amino acid patterns of the NPN fractions of 48 hours germinated pulses and beans may throw more light on the significant nutritive value observed for the 48 hours germinated moth bean and other pulses. One can again stress that the amino acid composition of 48 hours germinated grams will be of considerable importance in protein nutrition.

The results of the above studies have clearly indicated a marked improvement in the quality of proteins in Moth bean, Green gram, Cow pea, Red gram and Bengal gram at 48 hours of germination apart from a probable increase in the availability of the constituent amino acids. Nutrients other than protein are also known to improve with germina-

tion Many studies have shown an increase in ascorbic acid, Thiamine, Riboflavin, Nicotinic acid, Biotin, Pantothenic acid, Choline Vitamin B_{12}, Carotene and Tocopherol on germination. In view of this wholesome nutritive value of germinated pulses it is advisible to use these as supplements in infant feeding and to make these a part of the diets of children of school going age. Due to the improved digestibility of germinated pulses they can play an important role in the formulation of therapeutic diets, which require easily digestible and nutritious foods. Germinated pulses may be particularly effective in treating children suffering from protein calorie malnutrition since these grams have a good quality protein, are easily digestible and can be easily prepared from locally available pulses at a low cost.

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Hybrid Cereals and Legumes – The Food for Millions

Introduction

Asia accounts for about 55 per cent of the world's population but enjoys only 10 per cent of the world total income. India, with a population that is fast approaching the six hundred million mark, is adding every year 13 million mouths to be fed – a population equal to that of Australia. The death rate declined from about 35 in 1921–30 to about 15 in 1961–70, while the birth rate decreased only from 46 to 39 during the same period. A large percentage of this population is under 15 years of age. Nearly 70 per cent of the school children belonging to the poorer classes suffer from moderate malnutrition. More than two third of India's population cannot get a balanced diet even by minimum standards from the money it spends on food (Gopalan et al, 1969). Population projections at the present rate of growth indicate that the human production will out-manoeuvre agricultural production (Brown, 1972). The writing on the wall for a food crisis cannot be clearer than now. Nothing short of dynamic steps to minimise the population growth and maximise food production can offer hope to humanity.

We exist in an age of achievements. Genetic research has gifted us scores of high yielding varieties of food crops that result in bumper harvests heralding the oft quoted Green Revolution. Norman Borlaug's Mexican dwarf wheat and the International Rice Research Institute's rice varieties, notably the IR 8, have set the trend to fill the barns in the countryside.

The genesis of the accentuated food production programmes in India, can be traced to the 'Grow more food' campaign started in 1948. It was given special emphasis in the community development programmes that came into existence in 1952. Through the intensive agricultural district programme (1960-61) and the agricultural areas programme (1964–65), agricultural strategy was put on the vanguard.

The outlay for agricultural production in the public sector increased from a meagre 300 crores in the first plan to about 3000 crores in the fourth plan. Since the first plan, more than a score of schemes have been introduced to help the farmer and increase farm outputs. The ICAR, the CFTRI, the NIN and similar institutions all over the country have been engaged in the introduction of new varieties of food crops and evaluation of their nutritional content. The Programmes of the Govern-

ment have striven to give fiillip to streamline agricultural policy and to intensify the food production programmes through the extensive use of nutritious and high yielding varieties, efficient pest control–procedures, greater inputs of fertilizer and natural manure and a helpful and realistic agricultural credit policy.

The primary goal of all these efforts, is to provide a square meal to everyone in the country. a meal that meets at least the minimum nutritional requirements and thereby mitigate the evil of malnutrition. It is therefore important and highly useful that proper analysis of the nutrient composition of these high yielding new varieties of food grains is made.

The production of high yielding quality food grains and pulses is only an important step in the solution of malnutrition of the masses. They have to be of good cooking quality. Cheap and easy to prepare recipes, incorporating these grains, have to be developed and acceptability studies conducted, such that, the end products are palatable and nourishing. No effort should be spared to popularise and incorporate these grains and pulses into the habitual diets of the people such that the good that was conceived of them is realised.

Methods of Food Evaluation

Distinctions among foods made by the senses have been called sensory, organoleptic or psychometric. Acceptance or rejection of food is based largely on the stimulation of the sense organs of the individual. Each individual evaluates foods daily in terms of likes and dislikes. All the senses are used in the appraisal of food particularly those of sight, smell, taste and touch (Griswold, 1962).

Sensory (Subjective) Evaluation: Sensory methods, in which palatability is evaluated by a panel of judges, are essential to most food experiments because, they answer the all – important questions of how a food tastes, smells, looks and feels.

The objectives of sensory evaluation are to grade each sample according to its quality and to determine whether the acceptability of the experimental product is equal to or better than the standard. Sensory evaluation is used for many purposes. It is used in the development of new products such as mixes and instant beverages, which are modifications of traditional ones. Sensory evaluation is necessary for grading or rating foods and also for the selection of the best sample. It is also used to determine the sample that is preferred by the largest number of persons. Foods are evaluated for product improvement,

quality maintenance, the development of new products or analysis of the market value.

Since the taste response varies from taster, to taster the characteristic response of each taster to the four primary tastes i.e. sweet, salt, sour and bitter is studied in sensitivity tests. The concentration of the substances is determined as being easily recognised for the different tastes. In threshold tests, samples of solutions are arranged in order of increasing concentration. Actual samples are preceded by one or two blank samples i.e. distilled water. Only one primary taste and not more than seven samples for the taste are served at one session to avoid sensory fatigue on the part of the taster. Each taster is asked to mark the dilution at which he/she first obtained a taste sensation as "One and to mark the preceding dilution as 'O'. The members are selected based on the precision with which they detect a certain level of taste. Sensitivity tests and threshold tests are the screening tests generally employed in selecting taste panel judges. The members, who are sensitive to all the tastes at the middle dilutions are selected. They have to undergo discriminative tests, in order to be finally selected as panel members (Jellinek, 1964).

The triangle test is an important difference test, where the member's discriminative ability is recorded. The test received its name because three samples are presented to the panel members and the samples can be placed in a triangle form. Among these three samples two are alike and one is different. It is the task of the panel member to pick out in each triangle set, the sample which is different. The members with high scores are selected as taste panel members qualified to do the sensory evaluation (Amerine, Pangborn and Roessler, 1965).

Sensory tests are conducted in a quiet, clean and odour free room at a temperature of approximately 72°F. Taste panel sessions should be held preferably when the judges are neither well-fed nor too hungry. The environment is an important factor in judging food and should be without any distractions so that the tasters can concentrate. The room should be equipped with separate booths for each judge, so that he may be seated comfortably and separately while examining the sample. Judges should be provided with water for oral rinsing and adequate space for the samples and the score card. White containers or utensils may be used to serve food samples.

The number of judges needed in a given experiment will vary according to the variabilities of the individuals and of the product.

Small expert panels of 3 to 10 are preferred for laboratory studies. For consumer studies, hundreds or thousands may be needed (Lowe, 1965).

Objective Evaluation: The methods of evaluating food quality that depend on some measure other than human senses are often called "Objective". This is a classification that includes a wide variety of chemical, histological and physical tests.

The methods of objective tests are many. They offer a permanent record of results and invoke confidence because they are 'reproducible' and are less subject to error than sensory methods (Griswold, 1962).

In the pages that follow, are described several studies on the analysis of the nutrient composition of some of the high yielding varieties and the development of recipes that are cheap, easy to prepare and resembling the traditional ones such that they can easily be incorporated into the diets. Subjective and objective evaluations have been widely used for assessing the quality of the food preparations. The studies were carried out in the department of Home Science, S.V. University, Tirupati.

Hybrid Rice Varieties and their Cooking Quality

For nearly half the human race, rice and rice products constitute the staple food. It is the sole source of calories and the principal source of protein for the highly populous Asian countries. Rice yields the maximum calories per acre among the cereals. The Protein Efficiency Ratio, Biological value and Protein Utilisation figures compare favourably with those of wheat and maize. The digestibility of its protein is nearly 95 per cent (Rama Sastri and Sreenivasa Rao, 1969).

Since the major consumption of rice is in the form of cooked whole grain, the quality of cooked grain is a major criterion indicating its consumer acceptance. Rice must swell to maximum extent, have low bulk density and give separated grains and be of moderate pastiness. Short grain varieties have greater adhesive quality than the long grain ones (Halick and Kelly, 1959).

Six varieties of rice (four hybrid strains and two local viz., IR_5 IR_8, Padma, Hamsa, Co_{29} and BH_9) which are usually cultivated in Nellore district of Rayalaseema were studied for their physico-chemical properties and acceptability. The protein and starch content were analysed.

TABLE — 1

The Mean PercentProtein and Starch Content of Rice Strains.

S.No.	Variety	Protein g	Total Starch g
1.	Co_{29}	6.81	79.77
2.	BH_9	7.35	80.23
3.	IR_8	12.62	76.81
4.	IR_5	10.87	78.14
5.	Padma	12.62	76.85
6.	Hamsa	11.27	78.82

Comparing the protein and starch content of the Rice strains (Table-1) it was found that IR_8, Padma, Hamsa, and IR_5 had high protein content in that order, while BH_9, and Co_{29} had much lower content. The starch content was high for BH_9, Co_{29}, slightly less for IR_5 and Hamsa and much less for Padma and IR_8. But, they all ranged between 76.81 (IR_8) and 80.23 (BH_9). What is of value is their protein content. From the protein point of view IR_8, Padma and Hamsa (12.62, 12.62 and 11.27 respectively) have a higher range than the other three viz Co_{29}, BH_9 and IR_5.

The results of the cooking quality tests showed that the cereals Co_{29}, IR_8, IR_5 and Hamsa varieties with long grains, low bulk density and low water absorption, were superior in cooking quality to Padma and BH_9, which had medium or short grains, high density and high water absorption values. IR_8, IR_5 and Hamsa were similar in cooking quality to Co_{29} the most popular variety. BH_9, IR_8 and IR_5, Hamsa and Co_{29} had better gelling quality than Padma.

Comparing the time taken to get well cooked, of the different varieties it was found that IR_8 and IR_5 required about 29 minutes, Padma required 23 minutes while Co_{29}, BH_9 and Hamsa took about 25 minutes. Subjective evaluation by the six trained taste panel members indicated that, IR_8, IR_5 and Co_{29} were more cohesive (a score of 9) than Hamsa (7.96), BH_9 (6 09) and Padma (5.3). There was no difference in colour as they were all white. They did not have any off flavours. The water uptake ratios of the Padma, BH_9 and Hamsa varieties were more (2.27, 2.25 and 2.14) when compared to Co_{29}, IR_5 and IR_8 (1.83, 1.74 and 1.55 respectively).

When the cooked grains were examined, it was found that they were intact for Co_{29}, IR_8, IR_5 and Hamsa, while they were split for Padma and BH_9. The weights of raw rice grains per unit volume (20 ml.)

were Co_{29} - 17.34, BH_9 – 17.70, IR_8 – 17.25, IR_5 – 17.51, Padma – 17.68 and Hamsa – 17.49. The per cent transmittance (Starch – Iodine Blue test) indicated the following values, Padma – 84 6, BH_9 – 75.3 Hamsa– 70.0, IR_5 – 66.0, Co_{29} – 58.3 and IR_8 – 55.5. This test qualitatively indicates the amylose content of the samples tested. The higher the blue colour and the higher the amylose content, the better the cooking quality of the rice (Reyes, Albano, Briones and Juliano, 1965).

In another study (Hema, 1972) a similar analysis of the physico chemical characteristics and subjective assessment was done for 3 hybrid varieties of rice the IR_{20}, Jaya and Bairu. Results are presented in Table 2.

TABLE — 2

The Mean Protein and Total Starch Content of Three Strains of Rice.

Sl. No.	Strain	Total Protein g	Total Starch g
1.	IR_{20}	8.54	59.63
2.	Jaya	8.06	61.10
3.	Bairu (Red variety)	7.29	60.11

It is evident that among the three strains, IR_{20} has the highest protein with Jaya closely following. Bairu had the least protein content. Comparing these values with those obtained in the earlier study, it can be said that the Protein values of these 3 strains are far less except for Co_{29} and BH_{29}. The starch content was less than that of all the six varieties of rice reported earlier.

The gels of the 3 samples studied had the same amount of translucency while tests of their firmness indicated that IR_{20} had the highest and Bairu the lowest strength. As per springiness of gel IR_{20} obtained higher scores, with Jaya closely following. Bairu had the lowest values. IR_{20} was judged as the most smooth while Bairu earned the least scores in the study. The mean per cent transmittance (Starch – Iodine blue test) for the IR_{20}, Jaya and Bairu varieties was 92.2, 88.7 and 84.4 respectively. Their water uptake ratios were 3.08, 2.80 and 1.97 respectively.

The grains of Jaya were better separated than either IR_{20} or Bairu which were more sticky. Jaya had the least off flavour while it was marked in the case of Bairu. IR_{20} was the quickest to get cooked and Bairu was the last to get cooked.

Thus, cross comparing the results of various physico-chemical tests and subjective evaluations, it was found that Jaya had better consumer acceptance qualities than IR_{20} and Bairu. However, the hybrid varieties of rice in general were found to possess favourable physico chemical characteristics for consumer acceptance.

Hybrid Maize varieties and their Cooking quality

Maize is cultivated and consumed as a staple food during certain seasons of the year mainly in Uttar Pradesh, Punjab, Rajasthan and a few other states of India. Successful attempts have been made in India in evolving hybrid strains of maize, which are resistant to diseases and which give at the same time high yields. The yield of the composite varieties is on an average 4700 kg. per hectare compared to 900 kg. per hectare for the ordinary variety.

Starch comprises about 70 percent of the dry weight of the grain. The molecular make up of the starch can be varied through genetic control, thereby providing a variation in starch properties. A study was taken up (Padmavati, 1970) to estimate the total starch of a local, two composite and a hybrid varieties of Maize on a moisture and fat free basis. The total crude protein content of all varieties was estimated. The gelation properties were tested using fiours of these maize grains with a control sample of pure corn starch. In order to assess the cooking and acceptability qualities of these varieties of maize, custard, plain cake and halwa were prepared. The products were evaluated subjectively and objectively.

Three high yielding varieties namely Deccan Hybrid, Amber Composite and Sona Composite and one local variety of maize were selected for the study. The protein content was estimated by the standard microkjeldahl method. The starch content of maize was estimated using the acid hydrolysis and Lane and Eynon reducing sugar method (A.O.A.C. methods). The values were expressed on a moisture and fat free basis.

TABLE — 3

Mean Percentage Composition of Four Varieties of Maize for Total Starch and Protein.

Variety of Maize	Percent Starch g	Percent Protein g
Local	79.69	10.04
Sona Composite	79.75	11.29
Amber Composite	88.84	10.29
Deccan Hybrid	87.61	10.04

Amber Composite and Deccan Hybrid had more starch than local and Sona Composite and the differences were significant. Minor differences were observed in the protein content of the different varieties of maize.

When the gelation properties of the flours were tested, it was noted that the gels formed retained shape though they were not translucent, springy and smooth like the Standard Corn starch gel. In the local maize gel, syneresis was evident.

The per cent sag of the gels made of Sona Composite and local varieties of maize, was the highest. The standard, Amber Composite and Deccan Hybrid however, formed, firmer gels and their gel sag was low.

The sols made from the maize flours were assessed for their viscosity by the linespread test. In this test, the greater the area of spread obtained the lower is viscosity and vice versa. The sols were prepared with 25 grams of flour each. Sona Composite had the lowest viscosity while Deccan Hybrid, Amber Composite and local variety could be placed in this order in terms of decreasing area of spread or increasing viscosity.

The results obtained in the subjective evaluation of the recipes indicated that for all the three recipes studied, hybrid and composite maize preparations were rated either higher or on par with the local maize preparations for all physical attributes like colour, texture, flavour, taste and general acceptability. Hence these varieties of grains can be popularised amongst the consumers.

The viscosity of custard pastes made out of maize flours and a standard custard mix was recorded. The local, composite and hybrid maize pastes were less viscous than the standard paste since their areas of spread per unit time was greater. The Sona Composite, however, gave the least viscous sol.

When cake volume and cake weights were recorded and related to specific volume, it was noted that Amber Composite gave a product that had good volume that was comparable to that of the standard. Deccan Hybrid and Sona Composite gave cakes with a lesser volume and the

local variety gave a cake with the least volume. Correlation coefficients for texture and viscosity (area of spread), texture and specific volume and texture and breaking strength were calculated and found to be significant. This indicates the close relationship between the subjective and objective evaluations.

Amber Composite and Deccan Hybrid are of a higher order in both chemical composition and in cooking qualities. They have better cooking quality and acceptability when compared to the Local and Sona Composite. Amber Composite and Deccan hybrid are suitable for use as gelling agents in custards, as binders and structuring agents in cakes and as pasting agents to give smooth flavourful products as in halwa. The Sona Composite and Local varieties of maize do not measure up to yield quality food preparations. Of the two, the local variety was found to be the least suitable for cooking. The three hybrid and composite strains, i.e. Deccan Hybrid, Amber Composite and Sona Composite imparted pleasing colour and flavour to products such as halwa. These varieties are as acceptable and for certain recipes like halwa, more acceptable than the local strain of maize, and may therefore find a high consumer acceptability.

Hybrid Jowar and its acceptability

In certain parts of Rayalaseema and Telangana, people use millets either as staple food or at least for one meal in a day. The important ones among the millets are Jowar and Bajra. These are of great help in meeting the demand for food grains in rural areas. Many agricultural researches are focussed on high yielding hybrid varieties of these millets. It has been reported that one hybrid variety of Jowar, CSH, produced a grain yield of 7410 kg. per hectare compared to the local strain Co_{18}, which yielded only 1350 kg. per hectare. Governmental efforts are now directed on the cultivation and popularization of hybrid jowar, bajra and other millets (Sundaram and Venkataraman, 1966).

There are social prejudices against the use of these grains. They have always been regarded as a poor man's food. With the shortage of cereals particularly that of rice, and with the cultivation of hybrid varieties of millets, it is purposeful to popularise consumption of millets.

The origin of Sorghum Vulgare (Jowar) is generally attributed to tropical Africa. The chemical composition of jowar is not only dependent on the strain but also on the method of cultivation. The grain could be enriched, nutrientwise, by certain techniques pertaining to

mutation of genetic characteristics. The varieties so developed are to be evaluated in the laboratory for a detailed study of their nutrient composition and acceptability. Once this data is available, it could be used as a basis for the popularisation of these varieties in the households. Jayalakshmi, (1967) carried out a study on a hybrid strain of jowar and compared it with a local variety. The hybrid and local jowar samples were analysed for nutrient composition. Results are presented in table 4.

TABLE — 4

Percentage Nutrient Composition of Hybrid and Local Strains of Jowar.

Sl. No.	Nutrient	Hybrid Jowar	Local Jowar
1.	Moisture g.	10 08	10.02
2.	Protein g.	10.04	8.42
3.	Fat g.	4.20	4.31
4.	Calcium mg.	28.50	11.43
5.	Phosphorus mg.	208.02	321.84
6.	Iron mg.	6.05	6.17

The moisture, fat and iron present in the local jowar were not significantly different from that of the hybrid jowar. The phosphorus content was higher in the local strain. But the hybrid strain had more of protein and calcium in it compared to that of the local strain These differences were statistically significant.

Three different recipes were prepared with both the hybrid and local strains of jowar. They were standardised and evaluated for acceptance by laboratory taste panels for appearance, texture and taste. Local reports suggested that the village population was raising objections to the use of hybrid jowar on the basis of its inferior taste and flavour compared to that of the local strain. Therefore several village women were also asked to taste the three recipes prepared out of the two varieties of jowar and give their opinions. No information was given to them as to the type of jowar used in the recipes.

The three recipes viz–roti, laddu and dosai were standardised and served to the select panel members, who were selected on the basis of scores obtained in sensitivity, threshold and difference tests (paired comparison test or triangle test), The scores given for various palatability factors of each recipe were recorded. Three trials for each of these recipes were conducted on three different days. Average scores were calculated and the data was subjected to statistical analysis.

Results of sensory analysis for acceptability of hybrid jowar in various recipes indicated that the hybrid jowar roti was as acceptable as the local jowar roti. No significant differences were found in the scores given. Evaluation of the roti for acceptance at the village level showed that, out of 14 women, 11 did not find any difference between the two jowar varieties, one preferred hybrid jowar roti and two liked the local jowar roti better. On the whole, the villagers indicated that hybrid jowar roti was as good as the local jowar roti. Similar trend was observed for the laddu and the dosai prepared with hybrid and local jowar.

Intensive extension work in the villages is needed to popularise the hybrid jowar recipes. Frequent village visits and repeated education with the aid of puppet shows, dramas, stories, songs and with nutrition demonstrations involving preparation of recipes for tasting should be done. This type of approach establishes a firm rapport with the villagers, who are willing to try new foods and methods of preparation once they are convinced that the extension worker is sincerely interested in improving their status.

Hybrid Legumes and their Cooking quality

Legumes have a very high place in human diet and have proved to be very effective supplements. The word legume is derived from the Latin word 'Legumen' which means any leguminous plant. An alternative term for the edible seeds of leguminous plant is 'Pulse' from the Latin word 'Pulse' meaning pottage. The legumes in dry forms yield almost as many calories per unit of weight as cereals. The protein content ranges from 17 to 25 per cent, about double that of the cereals in general and slightly higher than that of meat, fish and eggs. Heat processing increases the digestibility of legume proteins, removes saponins responsible for the typical bitter taste in raw legumes and generally improves their flavour. Legumes are cheaper foods compared to flesh foods. They are within the reach of the poor. The need to enhance the production is great especially in countries like India where protein calorie malnutrition is rampant (Aykroyd and Doughty, 1964). Food shortage and malnutrition pose the gravest challenge to scientists and administrators. The current agricultural revolution, which has resulted in the development and propagation of several high yielding strains of food grains is bound to transform our food situation and make a significant contribution in overcoming the present gap between the availability and requirement of food. The phenomenal yields from such hybrids will undoubtedly augment our meagre supplies. The production of high yielding varieties by itself is not enough. It is necessary to assess the nutritional quality of these new

varieties along with the cooking qualities at the experimental stage itself before they are put into mass production. Further, it is necessary to find out whether these new varieties are acceptable to the population for which it is intended. It is here that the nutritionists role is high-lighted. They not only analyse the nutrients of these new finds but also develop new recipes or incorporate them into old recipes and test their acceptability. An investigation was undertaken in this direction by Rajyalakshmi, (1972). It concerned itself with the analysis of nutrients and to study the cooking quality of certain 'improved' strains and varieties of green gram. An attempt was made to relate the water imbibition capacities of these strains to the cooking quality through a common recipe.

Six improved varieties of greengram viz – Pusa Bisakhi, Kopergaon–1. Krishna–11, Jalgaon–781, PS–16, B–1 and one variety of Hybrid–45 were selected for the study. Locally available green gram was used for the purpose of comparison. These strains were analysed to find out the percent protein, fat and moisture content. Protein was estimated by the standard micro kjeldahl method, and fat and moisture by the indirect methods (Woodman, A.G. – Food Analysis). In table No. 5 the data is presented.

TABLE — 5

The Mean Percent Protein, Fat and Moisture Values of Different Varieties of Greengram.

Sl. No.	Variety of Greengram	grs/100g. of greengram		
		Protein	Fat	Moisture
1.	Local	24.32	2 312	11.41
2.	Hybrid-45	28.06	2.598	11.30
3.	Kopergaon–1	31.81	3.649	9.11
4.	Jalgaon–781	29.00	3.633	8.79
5.	PS–16	28.06	2.344	11.62
6.	B–1	30.89	2.547	9.02
7.	Krishna–11	25.27	3.633	7.87
8.	Pusa Bisakhi	25.27	2.555	10.90

The six improved strains and hybrid variety of greengram contained more amounts of protein than the local variety. Four of the six improved strains yielded around 28–32 grams of protein per 100g. This value is quite high when compared against the local variety which had only 24.3 g. percent. These differences in the values were statistically significant. Three improved varieties contained higher amount of fat than the local variety and the other three improved varieties and the

hybrid had almost the same amount of fat as the local variety. The moisture content was assessed with an idea that some relationship may exist between the moisture content and the imbibition capacity of the seed. Low moisture content might contribute to higher imbibition rate. Imbibition is usually considered to be basically a diffusion process, but capillary phenomena probably are also involved. When seeds are dropped in water, the seed coats are permeable to water and the seeds swell visibly. Imbibition capacity of different strains of greengram was assessed. A common recipe, "Sundal" was used for this purpose. The seeds were soaked in water for a certain amount of time and then cooked for a specified time and seasoned. During the process of soaking, the seed imbibes water and swells in size and this capacity to imbibe water may differ from seeds of one variety to another. The amount of water imbibed by the seed and the extent to which it swells can, to some extent, be related to the textural attributes of the final product (Hamad and Powers, 1965). To assess the differences in size and thereby in weights, 100 grains or seeds from each one of the varieties, were counted and weighed accurately in the analytical balance. They were soaked in 50 ml. of water and the temperature during imbibition was recorded. The soaking period of 10 hours was kept constant for all varieties. After this the seeds were removed from the water, draining off all the water by keeping the seeds to a side at an angle in the same vessel. The seeds were placed on a tissue paper, wiped gently on surface and then weighed. The amount of water left over was measured in a burette and recorded. This was repeated on three different days, for each one of the strains. Following the same procedure, "Sundal" was prepared with 100 grams of seeds of each variety and submitted to sensory evaluation. The results obtained (table-6) indicate that the varieties differed to a great extent in the size of the grain.

TABLE — 6

The Imbibition Capacity of the Grains of Six Improved Strains, Hybrid and Local Varieties of Greengram.

Sl. No.	Variety	Weight of 100 grains g.	Weight of grains after soaking for 10 hours g	Water absorbed (ml.)	Temperature during imbibition °C.
1.	Local	3 56	7.23	4.00	23 83
2.	Hybrid-45	3.83	6.13	3.66	23.83
3.	Kopergaon-1	4.96	9.00	5.00	24.66
4.	Jalgaon-781	5.60	9.66	5.30	24.66
5.	PS-16	4.70	8.23	5.00	24 83
6.	B-1	2.63	3.73	1.16	24.83
7.	Krishna-11	3.60	7.40	5.00	24.30
8.	Pusa Bisakhi	3.90	7.70	5.00	24.30

Kopergaon and Jalgaon varieties absorbed more water and they were given the highest scores for texture, taste and flavour in subjective evaluation of sundal prepared with them. The varieties PS–16, Krishna–11 and Pusa Bisakhi were alike in their imbibition capacity and the scores given for texture were also alike. The B–1 variety absorbed least amount of water and was given lowest scores both for texture and for taste and flavour.

Kopergaon and Jalgaon were rated high regarding all attributes. They yielded higher amounts of protein and fat per 100 grams and their imbibition capacity was good. The local and hybrid varieties, though they did not absorb water well, the scores given for texture were higher than that of other varieties like PS–16, Krishna and Pusabisakhi which absorbed more water. This difference might be related to the size difference among the grains. The size of the seeds of Jalgaon variety was largest with Kopergaon, PS–16 and Pusabisakhi following in decreasing order. The size of the seed was found to be related to its absorbance of water. Jalgaon seeds, which were bigger in size absorbed 5.3 ml. of water whereas the remaining three varieties each absorbed 5.0 ml. of water. The imbibition capacity which is once again related to the moisture content (and consequent low diffusion pressure of the water in the imbibant) and the water soluble pectin content thus might have influenced the texture of the whole gram. Scores given for texture in sensory evaluation, correlate to some extent with the imbibition capacity of the seeds of different varieties. Imbibition is dependent on the size of the grain, the temperature during imbibition, the pectin content of the seed coat and on the permeability of the seed coat.

From the results, it can be said that the improved and hybrid varieties of greengram were either as acceptable or more acceptable than the local variety. Through marketing and popularising such nutritious, high yielding and improved varieties of pulses, the general nutritional status of all segments of population can be improved to a great extent.

Termed as the miracle golden bean of the 20th Century, Soyabean has revolutionised the agricultural as well as general economy of the United States in the last 40 years. Soyabean is now the world's leading oil seed crop totalling about 35 million metric tonnes annually. Soyabean adapts to a wide range of climates and nearly all types of soils. Natural bacterial innoculation occurs in much of the regions where soyabean is grown extensively. Thus, it enriches but does not deplete the soil.

There is a demand for more than 10,000 to 12,000 tonnes of soyabean by the high protein food units. Soyabean can be put to a number of diverse uses as in the antibiotics industry, in making hydro-

genated vegetable oils and for use in the poultry and animal feeds. A programme for the development of soyabean has been taken up and a production target of 40,000 tonnes was envisaged by 1973–74 (Nutrition, 1972, NIN Quarterly Publication).

In a developing country like India, where caloric–protein malnutrition is widely prevalent, Soyabean can be used for the most urgent need as human food. For a long time to come, the malnutrition state in the country will have to be improved through improving existing vegetarian diets, as foods of animal origin like milk, meat, fish etc. are beyond the reach of many. This can be done by including more cereals and legumes in the daily diet (Rajalakshmi, 1969).

Soyabean is an oil seed with a high protein content. Fat is a concentrated source of energy and fat intake of most of our populations is poor. In this context, soyabean comes in handy as it is rich in fat and protein. Newer varieties of soyabean have been evolved by the agriculture research stations in an attempt to meet the crisis of food shortage. When the new varieties are developed, it is necessary to study their acceptability by the consumers. It is also important to analyse them for their nutrient composition, in order to get an idea about the extent of enrichment over the traditional varieties.

A study was undertaken by Shantakumari (1971) on six varieties of soyabean viz., Kanrich, K_{16}, EC 39824, EC 39821, EC 7034 and EC 14437. In the first part of the study the nutrients were analysed and the adverse effects like trypsin inhibitory activity and haemagglutinating activity were studied. This was done to test whether these varieties were free from such inhibitory factors and fit for consumption without much processing techniques as used with some of the other varieties. In the second part of the study six recipes were prepared with these soyabean varieties and the recipes were subjected to sensory evaluation as well as consumer response trials to see the extent of acceptability of soyabean in the Tirupati area.

For the analysis of nutrient composition standard methods were followed, protein was estimated by microkjeldahl method, fat by the indirect soxhlet extraction method, calcium by Clark and Collip method, phosphorus by Fiske and Subbarow method, iron by a colorimetric method, thiamine by thiochrome method modified by Swaminathan and riboflavin by the fluorimetric method. For estimation of anti–nutritional factors, trypsin inhibitory activity, the modified procedure of Anson was followed. For the haemagglutinating activity, as the method of Liener was not standardised, a method followed at CFTRI, Mysore was adopted.

The results obtained in the first part of the study are given in table – 7.

TABLE — 7

The Per Cent Nutrient Composition of Six Varieties of Soyabean

Varieties	Protein (g) Defatted Sample	Fat	Ash	Moisture	Phosphorus	Iron	Calcium	Thiamine	Riboflavin
		(g)	(g)	(g)	(mg)	(mg)	(mg)	(mg)	(mg)
EC 7034	40.82	28.85	5.3	6.03	320	14.7	213	0.70	0.69
EC 14437	40.82	27.68	5.6	5.55	320	10.5	210	0.77	0.65
EC 39824	44.65	28.68	5.6	5.65	260	13.7	293	0.76	0.89
EC 39821	36.99	33.61	6.0	6.74	460	15.0	390	0.75	1.34
K_{16}	40.82	27.38	5.7	6.01	320	10.5	213	0.73	0.77
Kanrich	36.99	31.70	6.2	6.42	380	14.2	213	0.76	0.78

The results obtained in this study agree well with the studies carried out earlier by other investigators. The slight differences in nutrient values among the soyabean varieties could be due to differences in genetic factors, soil conditions and fertilisers used. The protein, fat and mineral content of soyabean is very high when compared to the other common pulses.

The study of antinutritional factors in soyabean yielded information that the six varieties were free from Trypsin inhibitory activity, but somewhat high for hemagglutinating activity. Since these two non-nutritional factors are heat labile, they can be eliminated through different processing techniques.

Among the six varieties analysed EC 39824 seems to be more nutritious with many of the nutrients being higher than those of the other varieties. However, biological availability of nutrients was not tested. All other varieties of soyabean were fairly well comparable.

In the second part of the study the acceptability of the different varieties of soyabean was studied. The five light coloured varieties (excluding the black K_{16} variety) were mixed together and milled. This mixed flour was used in standardising recipes. K_{16} was powdered separately and its acceptability was studied using only the laboratory panel. Consumer acceptance was studied for the mixed variety flour, along with the laboratory panel assessment. Three sweet preparations viz – Halwa, Diamond Cuts and Mysorepak were selected along with three savouries viz – Pakoda, Murukku and Vada. These preparations were subjected to sensory evaluation along with a standard or basic recipe. Acceptability scores were recorded by ten panel members, who were finally selected after undergoing sensitivity, threshold and difference tests.

The results of sensory evaluation indicated that all the recipes with the mixed variety of soy flour were as acceptable as the standard recipe. For certain physical attributes they were given even higher scores than the standard recipe. But K_{16} which is black in colour, was given consistently lower scores for colour. Even regarding taste and general acceptability it was scored to be a little inferior to the standard recipe. From this, it is evident that all white varieties of soyabean could be successfully popularised. The black variety may be made more acceptable by dehulling or dehusking.

When consumer acceptance was recorded for Halwa, Pakoda and Murukku, it was interesting to note that 84 per cent of individuals (N= 346) who were tested, rated the Halwa as good, 14.7 per cent as acceptable and 0.9 per cent as not acceptable. A similar trend was observed in the evaluation of Pakoda and Murukku.

Nutrition experts have repeatedly suggested that the locally available, relatively inexpensive foods can be effectively used for prevention and control of malnutrition. In this context, judicious combinations of groundnuts, pulses and cereals which are available in India can be successfully used.

The major oil seeds cultivated in India are groundnut, coconut, sesame and cotton seeds, of which the first two occupy the first place in production. The utility potential of groundnut is increasing as newer fields for its utilization are identified (Parpia, Swaminathan and Bhatia, 1965).

Groundnuts are botanically known as Arachis Hypogaea, the name having been derived from a Greek word for a leguminous plant with the pods in the soil. Groundnut is essentially a tropical plant cultivated in almost all tropical and subtropical countries, upto an altitude of about 3500 feet. It adapts to a variety of climatic and soil conditions.

Pulses and oil seeds can contribute significantly to the protein content of the diet. It has been reported that practically in all the states surveyed, intake of legumes is less than the optimal level of 70 grams per day. The intake of pulses appears to be practically low in Andhra Pradesh, Tamilnadu, Kerala, Jammu and Kasmir. Groundnuts can suitably be added to the dietaries of people of all these regions.

In view of the population explosion and in order to provide adequate nutritious food for all, attention has been focussed in the recent years on the production of improved varieties of groundnuts that are of high nutritive quality, of adaptive habitat and of multifarious use

in human life (Cheena and Ranhotra, 1967). Five such improved varieties of groundnuts were studied as part of a research project by Ramadevi (1973).

In the first part of the study, the groundnuts were analysed for their protein, fat, total ash, calcium, iron, thiamine, riboflavin and niacin. The vitamins were estimated after subjecting the groundnuts to boiling and roasting. Standard methods were followed for the estimation of the macro and micro nutrients. The nutrient composition of the 5 improved varieties of groundnuts is given in table No. 8.

TABLE — 8

Mean Values for Percent Nutrient Compositon of Different Improved Varieties and a Local Variety of Groundnut

Sl. No.	Variety	Protein g	Fat g	Total Ash g	Calcium mg	Iron mg
1.	TMV — 7	40.42	51.28	2.70	95 97	6.48
2.	TMV — 2	35.77	49.24	2.56	86.79	5.40
3.	TG — 2	37.04	47.58	2.31	70.75	5.26
4.	FI — 5	40.27	49.25	2.70	91.60	6.24
5.	C — 421	37.83	48 34	2.49	73.69	4.87
6.	Local	28.46	42.04	2 25	58.78	2.36

Thiamine, Riboflavin and Niacin were estimated in the raw state and after subjecting the groundnuts to heat treatment like boiling and roasting. The loss of these vitamins on heat treatment was recorded.

TABLE — 9

Percent Thiamine, Riboflavin and Niacin Content of Raw and Cooked Samples of Improved Varieties and a Local Variety of Groundnut.

S.No.	Name of the Variety	Thiamine (mg)			Riboflavin (mg)			Niacin (mg)		
		Raw	Boiled	Roasted	Raw	Boiled	Roasted	Raw	Boiled	Roasted
1.	TMV — 7	1.158	0.694	0.943	0.428	0.341	0.406	17.893	16.993	17.723.
2.	TMV — 2	1.115	0.669	0.956	0.412	0.329	0.392	16.705	15.309	16.072
3.	TG — 2	0.994	0.596	0.852	0.363	0.290	0.355	15.278	14.201	14.978
4.	FI — 5	1.082	0.610	0.927	0.401	0.340	0.388	17.562	17.092	17.418
5.	C — 421	1.055	0.633	0.905	0.371	0.264	0.324	16.128	15.129	15.506
6.	Local	0.870	0.522	0.746	0.312	0.250	0.253	13.973	13.033	13.843

As is evident from table 8, all the improved varieties of groundnut had a higher nutrient content than that of the local variety. Among the varieties TMV – 7 was found to be superior in every nutrient analysed. The next best variety was FI – 5 followed by the other varieties TMV-2, C–421 and TG-2 in that order generally.

The effect of heat treatment on B vitamins which are present in higher amounts in these varieties was studied. The results revealed (table–9) that on boiling the thiamine loss was 38–40 percent and the riboflavin loss was 18–20 per cent. In the case of niacin, only 5 per cent loss was observed. Roasting produced less loss than boiling (about 15 per cent and 3 to 5 per cent for thaimine and riboflavin respectively) Therefore roasting is recommended to economise nutrient losses.

The second part of the experiment was concerned with the acceptability studies. The groundnut flour and bengalgram dhal flour were used in 1 : 1 ratio in all the recipes since the mutual supplementation results in good quality protein. The acceptability of the recipe was studied using subjective or sensory analysis. Three savories viz. – Pakoda, Dosai and Bonda and three sweets viz. – Laddus, Cookies and Payasam were prepared and standardised. All the recipes were as good as the basic recipe, which was prepared with the local variety of groundnut.

Since the recipes with improved varieties of groundnuts were given almost the same scores as for that of the standard, these varieties may be said to be quite acceptable. As the groundnuts are nutritionally improved varieties, popularisation of these through recipes, which are acceptable will help to improve the quality of diets in general.

The studies, reported in the foregoing pages, constitute attempts at assessing the nutritional quality of grains and seeds of some of the new high yielding crops and to study their acceptability as ingredients of traditional recipes.

The new varieties, by virtue of their high yields per hectare, not only constitute to a bulk produce but also considerably slice down the cost considered in terms of the profit they yield. It is thus common knowledge that per unit land, the produce is several times more than what the traditional varieties would yield. It means that with a little more investment and careful nurture these high yielding varieties can considerably step up production with no increase in the land under cultivation (Aiyar and Sreenivasa, 1972).

A high yield by itself is not enough. A high yield coupled with an improvement of the nutritional quality of the grain is necessary to

augment the benefits that accrue from the use of these new varieties. Such a choice would not only result in higher production bringing down the market price, but also enhance nutrient intake at less cost than would ordinarily be possible. Stated in simpler words, it means better health at less cost.

Combating malnutrition effectively among weaker sections of the population is a stupendous task. Mass production of high yielding nutritious food crops locally is a step of far reaching importance. Rice, ragi, maize, jowar, bajra and groundnuts together constitute a large portion of the foods consumed by the rural people of Rayalaseema. Hence the popularisation of the high yielding, nutritious varieties of these crops should be a significant target in the fight against under nutrition.

Popularisation of these new varieties by incorporating them into palatable cheap and traditional recipes is a very important subsequent step. It is often found that the rural folk harbour unnecessary and baseless misgivings pertaining to the use of these high yielding varieties. In this context it is significant to note that almost all the acceptability studies conducted in the department of Home Science, S.V. University, on some of the new rice, maize, jowar, greengram, groundnut and soyabean varieties yielded positive results. They have been found to be as acceptable as, if not more than, the traditional varieties.

Many among the rural people are not even aware of the large benefits that can accrue from the cultivation and use of these hybrid varieties. Carefully planned and practically oriented prestigeous demonstrations of traditional recipes incorporating the new varieties, is therefore essential. These efforts have to be sustained by the easy and continuous availability of the grains locally at cheap prices. Such a step would enable the rural folk to quickly reap the benefits arising from the development of new strains of cereals and pulses.

Knowledge comes through the senses. Man believes what he sees and hears. His convictions are influenced largely by the significant others around him. Above all he is a creature of habit and habits are acquired. Any method at popularisation of these new varieties of grains and nuts, which efficiently uses these facts can only succeed.

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Non Traditional Foods and their use in Standardised Recipes

Introduction

The adage "Discovery of a new dish adds much to human happiness than the discovery of a new star," is never more true than at the present time. This is so because the field of Food Science and Technology is expanding providing new foods at every point. The scientific study of these foods is necessary to develop and standardise newer recipes. People of the middle and high income levels are becoming less conventional in their food habits and eager to taste foods, which are not 'traditional'. Women are keen to add variety and novelty to the diets of their household. The intensity of their demand for new recipes can be felt by the inevitable cookery sections appearing in almost all magazines and the innumerable cook books coming into the market. However, not all recipes thus put forward can be called as 'standard' recipes though they appear appealing and enticing. A sound nutritional background may be missing.

In food science the term 'Standard' indicates a definite level of excellence desired in a food product or a recipe. A recipe when standardised should meet the specifications put down for a 'standard' recipe. A standardised recipe is an essential pre-requisite for controlling quality as well as the cost. Quality refers to the aesthetic satisfaction of the consumer as sensed by the organs of sight, touch, taste and smell. Aldrich (1953) is of the opinion that one should have a crystal clear concept regarding standards of the quality of food when standardising recipes. According to Graham (1953) standardised recipes are essential if one wants to serve quality food consistently. He advocates standardisation to improve a product if it is not acceptable; to determine the nutritive value of a recipe, to interest cooks in providing facilities for improving standards and to provide a means of determining the preferences of several people regarding recipes. Kelley (1953) suggests the use of good quality ingredients in the process of product standardisation. Adequate equipment and alertness to new developments in products procedures are the needed requisites for standardisation. The product standardised is evaluated by a panel of judges and improvements can be made by changes in the preparation of the ingredients or in the type or form of ingredients used. Ease of preparation and the availability of ingredients should also be recorded. Successive trials after adopting the changes which are recommended in the previous trial, are carried out until the product is satisfactory in all attributes. The

maximum number of trials given for each item is seven The process of evaluation is divided into two groups. (a) Sensory evaluation which measures the positive attributes of quality, which are classified into the categories of appearance as observed by the eye, kinesthetics as felt by hand or mouth, flavour and taste as by nose and mouth; (b) Objec tive evaluation which includes measurements of hidden attributes of quality, which the consumer is unable to evaluate by the use of senses.

Sensory evaluation indicates preferences or differences obtained by the use of the senses, whereas objective measurements refer to the data obained by physical, chemical or micro-biological means. Halliday (1937) and Boggs and Hanson (1949) suggest the combination of the two methods in the process of product evaluation for best results.

After subjecting a recipe to the evaluation methods, the quality of the recipe is pronounced to be either on par with the standard or above or below the standard. A food researcher aims at the first category. One comes across the second category very rarely whereas the third category product is improved into the second stage to bring it closer to the standard. Unlike the conventional foods the unconventional foods pose more problems to a food researcher during standardisation.

Some of the research work done in the Department of Home Science relates to the recipes which are standardised using new or unconventional foods. The unconventional foods studied include groundnut and sesame cake flours and varieties of fish protein concentrates. Recipes were also standardized with cane and palm gurs and non calorie sweeteners. Pork, a non traditional meat was also tested in various recipes for acceptability. Some of these foods were analysed for their nutritive value and results reported.

Groundnut and Sesame Cake Flours and their use in Indigenous Recipes :

The enormous problem facing mankind is in providing sufficient food to maintain the world's rapidly increasing population at present levels of health and working efficiency (FAO 1964). In the estimates of FAO, the world population figures will reach 4000 million in 1980. Of these only 800 million (20%) will be located in the wealthy industrial countries, while the remaining 3200 million (80%) will be living in the developing countries of the world subsisting on diets inadequate in quality and quantity in which protein and calorie deficiency will be the significant factors. Hence the search for new sources of protein rich foods began and one of the attempts is production and utilization of edible protein concentrates from oil seeds. Such sources as cotton seed, sesame, g oundnut, soya and coconut are the most promising protein rich raw materials available in developing countries.

It has been estimated that the annual world production of oil seed cakes is of the order of 20 million tons (Kuppuswamy et al 1968) and India alone produces about 3.5 million tons which would supply 2 million tons of protein. About half of this protein is from groundnuts (Achaya 1967). India produces 400,000 tons of sesame seed per anum. Nearly 77 per cent of this is utilized for oil recovery and the rest for edible purposes (Ramachandra et al 1970). In recent times much emphasis is laid on the use of press–cakes, the by–products of the oil industry which are valuable sources of protein at a low cost. Raw groundnuts contain 25–30 per cent protein, the expeller cake contains 45-50 per cent protein and the solvent extracted flour contains 55–60 per cent protein (Kuppuswamy et al 1968).

Any new product, however good it may be from the economic and nutritional stand point needs to be accepted by the individual consumer and the community at large. For this purpose the knowledge of the dietary pattern of the place and the type of food preparation in which the novel food can be incorporated must be located (Devadas 1967). In view of this point common recipes used in Tirupati area namely Halwa, Diamond Cuts, Mysore Pak, Vada, Pakoda and Muruku were selected and incorporation of low fat (expeller extract) groundnut cake flour and sesame cake flour were tried by Swarnalakshmi (1971). Both consumer and trained panel acceptability studies were carried out in the investigation.

Expeller extracted groundnut and sesame flours were obtained from CFTRI, Mysore. Analysis for protein, fat, moisture, total ash, thiamine and riboflavin content was done.

TABLE — 1

The Chemical Composition of Groundnut and Sesame Flours

Description	Protein	Fat	Moisture	Total ash	Thiamine	Riboflavin
	grams percent				mg per cent	
Groundnut Flour	51.5	8.8	9.8	4.5	0.966	0.229
Sesame Flour	45.0	14.9	5.8	5.9	1.038	0.087

The flours were tested as such or in recipes in the fresh state and at various periods of storage. The containers were varied as well as the temperatures of storage.

Results of the organoleptic evaluation of the flours and recipes during different periods of storage indicated that the changes in colour,

texture, flavour and taste were detectable more easily and at an early date in the flour than in the recipes. Offensive taste and odour were first developed in the samples stored at a higher temperature (43°c) in the mud containers. In coastal areas of Andhra Pradesh where the temperature may be nearly 43°c in summer, the flours packed in mud containers seem to keep well for 75 days whereas flours packed in tin containers seem to keep well for a longer period than those in mud containers i.e. 100 days. In areas like Tirupati where the room temperature ranges from 28–33°c for a longer period in a year, the study indicated that the flours packed in mud containers keep well for about 120 days and the flours packed in tin containers keep well for a longer period of 130 days. Whether low or high room temperatures, the tin containers were better than mud containers.

The study also revealed that storage losses of thiamine and riboflavin in groundnut and sesame flours were more at 43°c than at room temperatures of 28–33°c. The vitamin losses were greater in flours stored in mud containers than those kept in the tin containers. In summary low temperature storage in tin containers was found to be the best for preserving the quality of the seed protein concentrates. All the recipes standardised with ground nut and the sesame flours were accepted provided the storage conditions were good. The results of the consumer acceptability study indicated that the groundnut flour recipes are quite relished by a large percentage of the public.

The standardised recipes are as follows :

1. Groundnut / Sesame flour Halwa:

Ingredients	*Amounts*
Groundnut or Sesame flour	50 g.
Sugar	50 g.
Cardamom powder	¼ teaspoon
Raisins and cashewnuts	10 g.
Dalda	25 g.
Milk	100 ml. or enough to cook the flour.

Method:

1. Fry the flour with a little dalda
2. Add milk, sugar and stirr constantly
3. Add Dalda
4. Cook the mixture until it reaches halwa consistency
5. Add cardamom
6. Spread on a greased plate and garnish with raisins and cashewnuts.

Yield – 3 servings.

2. Groundnut/Sesame flour Diamond Cuts :

Ingredients	Amounts
Groundnut/Sesame flour	25 g.
Wheat flour	25 g.
Sugar	20 g.
Dalda (oil or dalda for frying)	25 g.

Method :

1. Prepare the dough using the flour, sugar and dalda
2. Roll out like chapathi and cut into pieces of diamond shape
3. Fry these pieces in deep fat till they are golden brown.

Yield – 2 servings.

3. Groundnut/Sesame flour Mysore Pak :

Ingredients	Amounts
Bengalgram dhal flour	25 g.
Groundnut/Sesame flour	25 g.
Sugar	50 g.
Ghee	100 g.

Method :

1. Fry the flour in a small amount of ghee
2. Make syrup out of sugar
3. Add the flour and ghee
4. Cook the mixture until it leaves the sides of the vessel
5. Pour into a greased plate and cut into desired shapes.

Yield 2 servings.

4. Groundnut/Sesame flour muruku :

Ingredients	Amounts
Bengalgram flour	17 g.
Rice flour	17 g.
Groundnut/Sesame flour	17 g.
Chillie powder	to taste
Salt	to taste
(Oil or dalda for deep fat frying.)	

Method :

1. Mix all the ingredients
2. Add water and knead into a fairly stiff dough
3. Divide into small portions
4. Feed into the 'Muruku Press' with appropriate disc inserted

5. Squeeze out into hot smoking shortening to form small rounds (murukus) and deep fat fry these rounds till brown on both sides.

Yield – 2 servings.

5. *Groundnut/Sesame flour Vada :*

Ingredients	Amounts
Bengalgram dhal	25 g.
Groundnut or sesame flour	25 g.
Onions	25 g.
Chillies	5 g.
Ginger	2 g.
Curry and coriander leaves	5 g.
Salt	to taste
(Oil or dalda for deep fat frying.)	

Method :

1. Soak bengalgram dhal in water for 6 hours and grind into a course paste.
2. Chop onions, chillies, curry and coriander leaves and ginger and grind to paste. Add chillie powder, salt and groundnut/ sesame flour to the ground paste and mix.
3. Take the mixture about the size of a small lime and flatten it on palm and deep fat fry until both sides are golden brown.
Yield – 2 servings.

6. *Groundnut/Sesame flour Pakoda :*

Ingredients	Amounts
Bengalgram dhal flour	25 g.
Groundnut/Sesame flour	25 g.
Rice flour	25 g.
Onion	25 g.
Chillies	5 g.
Curry and coriander leaves	5 g.
Salt	to taste
(Oil or dalda for deep fat frying.)	

Method :

1. Chop onions, chillies, curry and coriander leaves. Add salt, basen flour and groundnut flour or sesame flour and mix.
2. Take the mixture about small size of lime and deep fat fry, until golden brown.

Yield 2 servings

Fish Protein Concentrates and their use in Indigenous Recipes :

Another answer for the demand for new protein foods is the sea, which is not fully exploited for fisheries. The total annual catch of fish in India is about 1.4 million tons (Moorjani, 1970) which could be increased by making use of the available resources and fishing capacities. Fish protein concentrates (FPC) are lately being prepared from different fishes.

In a study conducted by Vijayalakshmi (1971) 6 varieties of FPC from (1) Eviscerated White Sardine, (2) Uneviscerated White Sardine, (3) Pink Fish, (4) Rainbow Sardine, (5) Opisthopsis and (6) Gizard were used. These were prepared in the meat, fish and poultry laboratories of CFTRI, Mysore. The nutrient composition of these concentrates with reference to crude protein, total ash, calcium and phosphorus was estimated which is presented in the following table.

TABLE — 2

Nutrient Composition of Fish Protein Concentrates

Sl. No.	Name of the fish	Nature of the raw material used	Total ash	Phos-pho-rus	Calcium	Protein
			Grams per cent			
1.	White Sardine	Uneviscer-ted fish	22.91	4.15	12.38	76.43
2.	White Sardine	Eviscerated fish	19.40	3.40	7.66	79.60
3.	Pink Fish	,,	14.51	2.70	4.32	85.41
4.	Rainbow Sardine	,,	10.39	1.64	2.64	89.56
5.	Opisthopsis	,,	12.04	2.14	4.68	87.90
6.	Gizard	,,	17.28	3.11	4.52	82.08

The nutrient composition of FPC from different raw materials differs to a considerable degree. A marked difference in nutrient composition exists between the eviscerated and uneviscerated samples of FPC, the latter having more of total ash and less of total protein compared to eviscerated samples.

The 6 varieties of FPC were incorporated at 2.5 per cent level into various recipes like Diamond Cuts, Pakodas (deep fat fried); Potato

Kachori (shallow pan fried); Biscuits (baked); Dhal Balls (steamed) and Sambar (boiled). Further, a comparison of the acceptability of eviscerated and uneviscerated White Sardine protein concentrates was done at 2.5, 5, 7.5, 10 and 12.5 per cent levels of incorporation in the above mentioned recipes. A trained panel of judges evaluated the products.

The eviscerated white sardine protein concentrate was more acceptable in all the recipes than the uneviscerated sample which may be accounted for by the darker colour and stronger flavour of the latter. This was true at all levels of FPC incorporation. Deep fat fried recipes like Pakodas and Diamond Cuts were the best accepted.

Shallow pan fried Potato Kachori was next best accepted. Steamed and boiled recipes such as dhall balls and sambar were the least accepted. The various recipes are presented as per the details of ingredients and methods of preparation.

Recipes standardized with Fish Protein Concentrates :

The specific fish flour is incorporated at the desired level by addition to either wheat flour or other flours or the vegetables as per the recipe.

1. Diamond Cuts :

Ingredients	Amounts
Wheat flour or maida	50 g.
Salt	to taste
Pepper powder	2 g.
Oil	for frying

Method :

1. Mix all the ingredients and make a dough using enough water. Add FPC and knead well.
2. Make small balls and roll them out into chapathies
3. Cut into diamond shaped pieces and deep fat fry.

Yield – 2 servings.

2. Pakoda :

Ingredients	Amounts
Bengal gram flour	1 cup
Rice flour	1 cup
Salt	1 teaspoon
Onion	1 medium

Green chillies	3–4
Baking soda	1 pinch
Dalda (unmelted)	1 teaspoon
Oil	for frying

Method :

1. Chop the onions, chillies and curry leaves
2. Add salt and baking soda and mix.
3. Mix bengalgram flour, rice flour and dalda
4. Add water and mix to a consistency of a loose dough. Add FPC at this stage
5. Fry small amounts of dough in oil. Cook till crisp and brown. Remove from the oil and drain.

   Yield – 4 servings.

3. *Potato Kachori :*

Ingredients	Amounts
Maida	70 g.
Potatoes	112 g.
Mustard	0.3 g.
Black gram	3 g.
Coriander leaves	0.3 g.
Green chillies	3 g.
Onion	14 g.
Turmeric powder	0.3 g.
Salt	3 g.
Water	22 ml.

Method :

1. Boil potatoes, peel and mash them well
2. Heat a little vanaspathi, prepare seasoning by adding black gram, mustard, chopped coriander leaves, green chillies and onion.
3. Add turmeric and salt to the seasoning
4. Add potato mash and fry for some time and keep aside
5. Make a dough by mixing maida, water and vanaspathi
6. Devide the dough into small balls, roll out and fill each puri with the potato filling
7. Fold the puri and flatten it slightly and shallow- fry using vanaspathi.

8. The fish protein concentrate is incorporated into the mashed potato and fried.

Yield – 3 servings.

4. Sambar :

Ingredients	Amounts
Red gram dhal	28 g.
Vegetables	56 g.
Oil	3–4 g.
Salt	3–4 g.
Tamarind pulp	6–8 g.
*Sambar masala	8–10 g.
Mustard	a little
Curry leaves	a few
Water	as required

Method :

1. Clean the red gram, boil in water till it becomes very soft and all the water is absorbed. Mash. Add FPC at desired level to the mash and mix.
2. Soak the tamarind in 1 oz. of water and prepare an extract.
3. Cook the vegetables separately in minimum amount of water. When soft, add tamarind extract, pulse mash, curry leaves and other ingredients except mustard and oil.
4. Boil to a thick consistency
5. Fry mustard in a little oil and add to the sambar.

Yield – 2 servings.

*Sambar masala : Fry and grind the following ingredients together into a fine powder, coriander seeds – 226g., pepper 2.8g. cummin seeds 3.5g., chillies 448 g , fenugreek seeds 3.5g, and asafoetida a little.

5. Steamed Dhall Balls

Ingredients	Amounts
Redgram dhal	30 g
Onions	10 g
Green chillies	10 g
Curry leaves	a few
Coriander	a few
Salt	to taste

Method

1. Clean and soak the dhal in water for about 1–1½ hour.
2. Grind to a course paste with the addition of very little water. Add FPC to this paste and mix.
3. Add salt.
4. Cut onion, chillies and coriander leaves and add the ground dhal and mix.
5. Make oval shaped balls and steam cook.

Yield – 1 serving.

6. *Sweet Biscuits*

Ingredients	Amounts
Wheat flour or Maida	84 g
Sugar	28 g.
Vanaspathi	14 g.
Baking powder	1 g.
Water	22 ml.

Method

1. Powder sugar and seive along with flour and baking powder. Add FPC to this flour and mix.
2. Add vanaspathi and make into a medium stiff dough with water.
3. Roll out the dough into a ¼" thick chapathies, cut into rounds or squares and bake in an oven at 232°c.

Yield – 3 servings.

Cane and Palm Gurs and their use as Sweetening Agents:

Since time immemorial sweetening agents are being used in food preparations. Honey from bees was one such source. In some countries juice extracted from certain types of grasses was concentrated into a solid form and was used as sweetening agent (Meade, 1951). Later on Indians and Chinese extracted juice from the stalk of a bamboo like tree what is now called as sugar cane (Peckham 1964).

With the development of civilization the juice was concentrated into a solid form which is now known as jaggery and later on with the impact of science and technology sugar was manufactured. The manufacture of jaggery from palm trees was also a common practice in India, and is still prevalent. Palmgur is obtained by tapping the young inflorescence of the palm trees. Originally palm gur was used for medical purposes. Due to shortage of sugar and jaggery, people became awaer of other available sweetening agents and as a result palmgur has come into light as a sweetening agent.

The studies on the chemical composition of different varieties of gurs have emphasized the analysis of minerals, vitamins total reducing and non reducing sugars.

Bhyravamba (1968) assessed the usefulness of locally available gurs. Two grades of gur each of cane and palm available in the local market (Tirupati) were selected for the study. These were analysed for moisture, total reducing sugars, sucrose. tota' ash, phosphorus and iron. Effect of storage on moisture, PH and other characteristics of the gurs was also tested.

The results showed that the total reducing sugars and phosphorous content of canegur was significantly higher than that of palmgur. But the iron and the sucrose content of the latter was markedly greater than that of the former as seen from table 3. The values are presented per 100 g. on dry weight basis.

TABLE—3

Nutrient Composition of Different Sweetening Agents.

S. No.	Nutrient Percent	Canegur A	Canegur B	Palmgur A	Palmgur B
1.	Ash g.	1.23 ± 0.12	1.04 ± 0.03	2.84 ± 0.14	2.79 ± 0.01
2.	Moisture g.	6 20 ± 0.32	7.32 ± 0.39	8 20 ± 0.01	8.90 ± 0.06
3.	Total reducing sugars g.	21 30 ± 0.04	18.04 ± 0.11	2 29 ± 0.12	2 04 ± 0.16
4,	Sucrose mg.	64.15 ± 0.04	62.05 ± 0.04	74.95 ± 0 10	73 01 ± 0.23
5.	Phosphorous g.	0.13 ± 0.01	0.08 ± 0,01	0 03 ± 0.01	0.02 ± 0.006
6.	Iron mg.	13.30 ± 0.11	12.61 ± 0.03	18.31 ± 0.11	16.25 ± 0 03

During the storage period of 60 days at room temperature the change in chemical characteristics was the same for both the gurs. As the storage time increased moisture content of the gur increased accompanied by a decrease in PH and an increase in turbidity. Marked differences were not observed between canegur and palmgur.

Three recipes – Athirasam, Laddu and Pittu were standardised for acceptability using all the experimental gurs. The results of taste panel scoring showed that there was a difference between the gurs for colour, taste and general acceptability. Canegur A was the best accepted sweetening agent for all the recipes standardised and the second preference was given to palm gur. Products using cane gur B obtained the

lowest score indicating the unacceptability of canegur B. Since the cost of canegur A is high, palmgur can be recommended and popularised as a cheaper substitute in place of canegur specially since it is well accepted.

Standardised recipes with Cane or Palm Gur :

Athirasam :

Ingredients	Amounts
Rice flour	100 g.
Sweetening agent	50 g.
Water	35 ml.
Gingelly seeds	10 g.
Cardamom powder	3 g.

Method :

1. Soak rice for 3 hours
2. Wash and drain. Pound the rice and sieve through a 20 mesh sieve.
3. Dissolve the gur and filter using 15 ml. water.
4. After filtration add 20 ml. water and cook the syrup to soft ball stage.
   (For cane jaggery 'A' 117-120c°, for cane jaggery 'B' 119-121°C. for palm jaggery 'A' 114-116°C for palm jaggery 'B' 116-118°C.).
5. To this syrup add rice flour, gingelly seeds, cardamom powder.
6. Take 30 g. of the flour mixture and spread evenly on a banana leaf till it is 0.3" thick and has 2.5" diameter.
7. Heat oil to 190°c and cook for 2 minutes.

Yield - 4 servings.

Laddu :

Ingredients	Amounts
Jowar flour	200 g.
Sweetening agent	200 g.
Water	100 ml.
Roasted groundnuts	60 g.

1. Dissolve the gur in 50 ml. of water and filter.
2. Roast the jowar flour for 15 minutes on a slow fire to remove the raw flavour
3. Heat oil in a vessel and add roasted jowar flour and mix

4. Pour the jaggery syrup and 70 ml water, roasted groundnuts and mix well with a wooden spoon on a slow fire at 108°C for five minutes.
5. Stir now and then to avoid charring at the bottom of the vessel.

Yield – 8 servings.

NOTE:– In the case of cane jaggery there is no need for preparation and filtration of syrup.

Bajra Pittu:

Ingredients	Amounts
Bajra flour	100 g.
Water	20 ml.
Sweetening agent	25 g.
Grated coconut (dry)	15 g.
Cardamom powder	5 g.

Method:

1. Roast bajra flour for fifteen minutes to remove off flavour
2. Moisten with 20 ml. of water and steam for 30 minutes in an idli vessel. Remove from the fire and add powdered gur, grated coconut, and cardamom powder and mix well.

Yield – 2 to 3 servings.

Standardization of Jellies with Sucaryl and different bodying agents:

Jams, Jellies and Marmalades are an important class of products among the preserved foods. Jelly belongs to the class of colloidal systems known as 'gels'. Gels are semi-rigid and elastic systems formed from colloidal solutions or 'sols'. Pectin serves as the chief bodying agent in jellies. Gelation of the pectin is brought about by alcohol or glycerine. In this reaction, some investigators believe this sugar, alcohol and glycerine precipitate pectin by acting as dehydrating agents. The rigidity of gels indicates that they have structure. It seems probable that hydrogen bonding is responsible, atleast in part, for the rigidity of fruit jellies (Griswold, 1962).

Jelly is prepared by boiling the fruit with or without water and the clear extracted juice containing the pectin is combined with sugar and then it is boiled to a stage at which it will set into a clear gel on cooling.

Sugar is an essential constituent in the preparation of jelly. If the amount of sugar added is high, a syrupy jelly is the result, but if little quantity of sugar is added the jelly is firm. The concentration of sugar desirable in the finished jelly varies with the fruit juice from which the jelly is made. Giridharlal et al (1969) stated that the proper amount of sugar to be added to a fruit extract is directly propotional to the amount of pectin and acid present in the extract.

Jellies are popular items of diets and they are relished for their textural attributes and sweet taste. Since they have a firm shape they are coloured and used for decorative aspects of recipes. Such attractive items cannot be removed from diets. They are used even in low carbohydrate diets with non calorie sweeteners. Glickman and Yarkas (1966) have observed that the consumer groups for which low calorie products are designed are (1) Over weight people; (2) Children who crave large quantities of sugar - sweetened foods; (3) Diabetics and pregnant women, who if overweight run extra risk and must watch their calories. Apart from restriction of use of sugar in low carbohydrate diets sugar, as such, is an expensive commodity making jelly production a costly venture. So to serve the twofold purpose of retaining jelly on the menu of low calorie consumers as well as making it available to the low socio economic group, non-calorie sweeteners are introduced in place of sugar.

The two most important synthetic sweeteners on the market are saccharine and cyclamates since these are the only ones currently considered safe for use in foods The cyclamates are 30 times sweeter than saccharine and saccharine is 300 times sweeter than sugar (Jolyson, 1966). From the flavour standpoint the best results have been obtained by using the cyclamates and saccharine in combination which is known as sucaryl. The proportions used can be in the ratio of 1 to 1 by weight or to 20 to 1 of cyclamate to saccharine. Bottle (1966) has said that the economic advantages of synthetic sweeteners over sugar are two-fold. The obvious one is that a given degree of sweetness can be obtained at a low cost. The less obvious advantage comes from savings in transport, storage and handling involved in the use of sugar.

Glickman and Yarkas (1966) compared the properties of sugar with those of non-calorie sweeteners and discussed the relative advantages and disadvantages of each type of sweeteners with regard to food preparations. Sugar, apart from being the sweetening agent, also serves other important functional properties in food systems. Unlike the artificial sweetener it is a good agglomerative medium. This property is essential in food preparations if the appearance, dispersibility or density of food products have to be improved. Non-calorie sweeteners are not good

agglomerative agents. Sugar is highly soluble and dispersible in water whereas non calorie sweeteners are not. However, since only small quantities of the latter are used, problems due to low solubility and dispersibility may not arise

Sucrose has the ability to blend or enhance many flavour characteristics in a wide variety of foods so as to improve their flavour qualities and acceptability. Artificial sweeteners have undesirable bitter after taste in many applications. While these tastes can be minimised or masked they need to be successfully eliminated Chemically sucrose is a non-ionic compound that does not interfere or react with most food constituents, whereas the commonly used artificial sweetners usually sodium or calcium salts sometimes create problems through cationic reactions with other food or flavour ingredients.

High concentrations of sugar have an important preservative effect, a fact carefully considered in the preparation of syrups and toffies which often specify sugar concentrations of 65 per cent or higher. But the synthetics do not make such a contribution to the preservation of foods. The use of an artificial sweetener demands an additional preservative. Though the non-calorie sweeteners are not utilized as a source of nutrients by micro-organisms, the other ingredients in a food system necessitate addition of normal preservatives (Jolyson, 1966). Non-calorie sweeteners are compatible with all chemical preservatives such as benzoates. Non-calorie sweeteners are also stable to pasteurizing and sterilising temperatures. So, they can be safely used in all commercial procedures for preservation of foods.

Broeg (1965) states that characteristics like texture and consistency are contributed to foods by sucrose. If artificial sweeteners are used, some bodying agents like hydrocolloids have to be incorporated to bring about the desired mouthfeel and texture of the body in foods like Jams and Jellies. Hence it becomes necessary to evaluate the different bodying agents with reference to their effect on textural attributes of these foods, and their acceptability when non calorie sweeteners are incorporated.

An attempt was made by Savithri (1968) to study and evaluate various bodying agents in context to the use of sucaryl in the standardization of grape jellies. The bodying agents like gelatin, commercial pectin, agar-agar and the pectin extracted from tamarind seeds were used to suit home conditions and processing. Jellies thus prepared with different bodying agents were compared with a standard jelly made with sugar. The jellies were evaluated by subjective and objective methods. The proportions of ingredients and the methods of preparation for all variations are presented.

Standardized Jellies with sugar or sucaryl and different bodying agents :

1. *Sugar Jelly*

Ingredients	*Amount*
Grape Juice	1 cup
Sugar	¾ cup

Method :

The juice was boiled uncovered, in a broad aluminium vessel for 3 minutes. It was removed from heat and tested for pectin (To 1 tsp. of alcohol in a test tube add 1 tsp of juice and blend quickly together. Keep aside for ½ minute. If a jelly like mass or clot is formed the juice contains a sufficient amount of pectin).

Then the sugar was measured and added slowly to the hot juice. It was boiled briskly uncovered removing the scum that was formed till it reached the temperature of 103 to 104°c.

The finishing point of the jelly was tested by sheet test method and it was removed from the fire, cooled for 1 minute and then the last bit of scum was removed with a cold fork or spoon. The liquid was finally carefully poured into the containers and allowed to cool.

Yield – 4 servings.

2. *Commercial Pectin Jelly*

Ingredients	Amounts
Commercial pectin	24 g.
Grape juice	1 cup or 16 tbsp.
Glycerol	1 cup ,,
Sucaryl tablets	8 nos.

Method :

The pectin was soaked in 6 tbsp of water. Sucaryl was dissolved in the hot grape juice and this juice was added to the soaked pectin and heated until it dissolved well. Then the glycerol was added and boiled for 1 minute. The vessel was removed from the fire after doing the sheet test. The liquid was allowed to set in suitable containers.

Yield – 4 servings.

3. *Gelatin jelly*

Ingredients	Amount
Gelatin	3 tbsp.
Grape Juice	1 cup
Sucaryl tablets	8 nos

Method :

Gelatin was soaked in 1 cup of water. Sucaryl tablets were dissolved in the hot grape juice. This hot juice was added to the soaked gelatin and heated until it dissolved fully and when the mixture reached the finishing point it was removed from the fire and cooled.

Yield – 4 servings.

4. Agar–Agar Jelly

Ingredients	Amounts
Agar agar	9.6 g
Glycerol	1 cup
Grape Juice	1 cup
Sucaryl tablets	8 nos.

Method :

Agar–agar was soaked in 16 tbsp. of water and the rest of the procedure was as for commercial pectin jelly.

Yield – 4 servings.

5. Extracted Tamarind Pectin Jelly

Ingredients	
Extracted pectin Solution*	24 tsp.
Glycerol	1 cup
Grape Juice	1 cup
Sucaryl tablets	8 nos
Lime Juice	8 tsp

(*5 tsp of roasted dehusked tamarind seed powder was dissolved in 1 cup of water and was soaked for atleast 4 hours. Then it was filtered through a fine cloth. The filtrate was allowed to settle and a portion of the clear, supernatent liquid was tested with alcohol for pectin after 3 minutes boiling. It indicated a high concentration of pectin. Hence the supernatent solution was used as the bodying agent in amount stated above for the recipe).

Method :

Grape juice was boiled for 3 minutes and the test for pectin was conducted. The sucaryl tablets were dissolved in it. The extracted pectin solution was added to this mixture and mixed. Next glycerol was added and boiled for 1 minute. The syrup was removed from the fire and lime juice was added to it. Jelly was allowed to set.

Yield – 4 servings.

In the pectin jelly glycerol was used to precipitate the pectinase in amounts equal to the amount of juice and in the case of agar–agar 16 tbsp glycerol was added per cup of juice. The other types of jellies did not require glycerol.

In all this work with sucaryl and different bodying agents it was found that the jellies were satisfactory from the consumer angle. The jelly, which was preferred by the taste panel was the one made with pectin extracted from tamarind seeds. In the objective evaluation this was almost identical with the standard sugar jelly. It contained 64 percent total soluble solids and had a PH of 3 3 and exhibited a gel percent sag of 7.37. The standard sugar jelly had 65 per cent total soluble solids, a PH of 2.8 and a gel percent sag of 7.67.

When different jellies were compared the one made with pectin was more acceptable than the conventional sugar jellies. Jellies made with agar–agar were not preferred and jelly made with gelatin had the lowest rating. It is highly satisfying to note that the jelly made from pectin extracted from tamarind is superior to the others and also of low cost. It can be a boon to the house–wife, who cannot afford to make commercial sugar jellies. The introduction of sucaryl as the sweetener, place these jellies at an even more advantageous position from the point of the consummers, who have to be on low calorie diets. They can derive the normal satisfaction from jellies made with sucaryl without worrying either about calories or about the sugar.

Pork – a nontraditional food - its acceptability in standardized recipes :

Pork includes the flesh of a suckling pig to a mature medium size pig 5 to 9 months of age. It's flesh is fine and firm with a minute layer of fat coating the fibers ; the colour is grayish pink ; the fat is smooth and white ; and the bones are soft and tinged with red (Robinson, 1970). In the present challenge posed by enormous widespread protein hunger both qualitative and quantitative in nature it cannot be gain said that pork production can substantially meet the situation better than most other animal production enterprises (Narayana Rao, 1970).

In India pork is at present a non-traditional food to the majority of people. When the pork industry is developed to its full potential the cost of pork will be much cheaper than that of other animal foods and this meat may then slowly find a place in the common man's diet. The use of pork as a valuable substitute for mutton should be realized. In this context popularizing pork through attractive and acceptable dishes becomes a present day need. With this view studies were untertaken by

Vijayalakshmi Kumari (1970) to evaluate the acceptability of different cuts of pork in the form of different recipes. Representative samples from shank, belly, blade, ham (Semi membranous adductor) and longissimus dorsi of five pigs were evaluated in six recipes for each cut for general acceptablity, colour, flavour, juiciness and tenderness, by a semi-trained panel. The riboflavin content was estimated both in the raw and cooked pork samples under objective assessment. Keema Matar, Pork Vindaloo, Pork Curry, Pork Masala, Pork Chops Braised and Braised Pork were the six standard recipes by which the different pork cuts were prepared and served to the panel. The maximum score allowed for each recipe was 10. General acceptability of the different cuts varied with the recipe and method of cooking. The decreasing order of cuts for each recipe as per taste panel scores was as follows.

1. *Keema Matar :*

   Shank, Semimembranous Adductor, Longissimus Dorsi, Belly and Blade. Range of score 7.2 to 5.5.

2. *Pork Vindaloo :*

   Shank, Longissimus Dorsi, Semimembranous Adductor, Belly and Blade. Range of score 7.2 to 5.5.

3. *Pork curry :*

   Semimembranous Adductor, Longissimus Dorsi, Belly, Blade and Shank. Range of score 7.2 to 5.5

4. *Pork Masala :*

   Belly, Longissimus Dorsi, Semimembranous Adductor, Shank and Blade. Range of score 6.6 to 5.7.

5. *Pork Chops Braised :*

   Semimembranous Adductor, Longissimus Dorsi, Blade, Belly and Shank. Range of score 7.9 to 5.8.

6. *Braised Pork :*

   Semimembranous Adductor, Longissimus Dorsi Blade, Belly and Shank, Range of score 6.6 to 5.7.

The subjective evaluation generally indicated a preference for cuts of Longissimus Dorsi and Semimembranous Adductor. Belly, Blade, and Shank cuts were less preferred with Blade being the least accepted in many of the recipes prepared.

The recipes standardised are as follows.

1. *Keema Matar :*

Ingredients	Quantities
Minced Pork	250 g.
Peas	200 g.
Onions	2
Garlic	6 pods
Ginger	½ inch piece
Tomatoes (sliced)	2
Turmeric powder	½ teaspoon
Green chillies	2
Cinnamon stick	1 piece
Cardamom	2 whole
Cloves	1 whole
Curds	⅔ cup
Fat	2 table spoons
Water	1½ cup
Salt	to taste

Time for cooking 35 – 40 minutes.

Method :

1. Mix all the ingredients together in a deep pan except peas and tomatoes and cook them over medium heat until all the liquid from the end curds is absorbed.
2. Then cook the mixture to a light brown colour for twenty minutes, stirring it constantly. Add peas, tomatoes and water. Cook it on a low fire for fifteen minutes until peas and meat are tender.

Yield – 4 servings.

2. *Pork Vindaloo :*

Ingredients	Quantities
Pork	250 g.
Vinegar	2½ table spoon
Cumin seeds (Powder)	1 tea spoon
Mustard powder	1 tea spoon
Turmeric powder	1 tea spoon
Red chillies powder	1 tea spoon
Garlic	14 pods
Ginger	½ inch piece
Cloves	3 nos.
Cinnamon sticks	2 nos.
Cardamom	3

Onions	2
Fat	1 table spoon
Salt	to taste
Water	2½ cup
Time for cooking 55 minutes	

Method :

1. Grind to paste cumin powder, mustard powder, turmeric powder, chillies powder, 4 pods of garlic, ginger, 2 cloves, one cinnamon stick, cardamom and 1 large onion and salt to taste.
2. Mix the ground paste with vinegar and soak meat in the mixture for 4 to 5 hours.
3. Fry sliced onions, pods of garlic and a piece of ginger in fat.
4. Add meat mixture and let it simmer on a low fire in a tightly covered vessel until the meat is soft and done and ready to serve.

Yield – 3 servings.

3. *Pork Curry*

Ingredients	*Quantities*
Pork	250 g.
Red chillies	3 nos.
Goriander powder	5 g.
Cumin	¼ teaspoon
Pepper corns	2 nos.
Turmeric powder	⅜ teaspoon
Onion	160 g.
Tamarind	1.6 g.
Garlic	2 g.
Green chillies	2 nos.
Ginger	¼ inch piece
Curry leaves	A few sprigs
Garam masala	⅛ tsp. (available from Market)
Cinnamon and cloves	2 g.
Potatoes	75 g.
Fat	5 g.
Vinegar	25 ml.
Water	3 cups

(Time for cooking 45 minutes)

Method :

1. Clean and cut pork into 1 inch cubes.

2. Roast coriander seeds and red chillies and grind to fine paste with cumin, pepper, turmeric, half the onion (80 g.) and the tamarind.
3. Slit green chillies, slice ginger, garlic and remaining onion.
4. Boil cloves and just enough water to cover pork.
5. Add sliced ingredients and peeled and quartered potatoes and cook over a slow fire.
6. Fry the ground paste.
7. Add meat and potatoes and water if required. Simmer for a few minutes till the fat floats on top and meat and potatoes are cooked. Remove from the heat and serve.

Yield – 4 servings.

4. *Pork Masala*

Ingredients	*Quantities*
Pork	250 g.
Red chillies	2 nos. (medium size)
Onion	150 g.
Cumin seeds	½ teaspoon
Turmeric powder	⅛ teaspoon
Pepper corns	3 nos.
Ginger	½ inch piece (10 g.)
Garlic	1 flake (10 g.)
Vinegar (synthetic)	15 ml.
Salt	to taste
Potatoes	60 g.
Water	3 cups

Method :

1. Clean and cut pork into even sized cubes (1 inch pieces)
2. Roast red chillieis and powder them.
3. Mix pork, red chillies powder and salt and set aside for 15 minutes.
4. Slice 100 g. of the onions and add to the pork along with 1 cup of water.
5. Cover and simmer till the meat is tender (30 minutes)
6. Grind remaining 50 g. of onions, cumin, turmeric, pepper corns, ginger and garlic to a smooth paste and add to meat the vinegar. Continue to simmer for further 15 minutes.

7. Add boiled, peeled and sliced potatoes later and heat for five minutes and remove from the fire and serve.

Yield – 4 servings.

5. *Pork Chops Braised*

Ingredients	*Quantities*
Pork	300 g.
Turmeric	1 pinch
Chillie powder	½ teaspoon
Pepper corns	0.25 g.
Onions	33 g.
Garlic	1½ flakes
Salt	to taste
Vinegar	½ teaspoon
Fat	16.6 g.
Potatoes	70 g.
Water	3 cups

(Time for cooking 40 minutes)

Method :

1. Apply ground spice on chops, set aside for half an hour.
2. Fry lightly on both sides and remove.
3. Fry Potatoes and onion in the same fat in strong bottomed pan; pour remaining fat on the preparation.
4. Place potatoes and onions at the bottom and chops on top. Half cover with water, put on a light fitting lid and cook on the stove until pork and vegetable are tender.

Yield – 3 servings.

6. *Braised Pork*

Ingredients	*Quantities*
Pork	250 g.
Fat	10 g.
Curry powder	¾ teaspoon
Garlic	1¼ flake (5 g.)
Vinegar	½ teaspoon
Tomato puree	¾ tablespoon (1 tomato)
Bay leaf	½
Onions	1½ (80 g.)
Carrots	80 g.
Water	2½ cups

(Time for cooking 55 minutes)

Method :

1. Cut pork into thick slices (1 inch thick)
2. Melt fat and brown meat on either side, place in a large cast iron or thick bottomed pan.
3. Rinse out frying pan with a little water and pour over meat.
4. Grind together curry powder and garlic. Mix with vinegar and water, add the tomato puree and bay leaf and pour over meat.
5. Cover and simmer on the stove till ¾th done.
6. Peel and slice onions. Peel and cut carrots into strips.
7. Add the vegetables to the pot and simmer for a further 20 minutes.

Yield – 4 servings.

Riboflavin was estimated in raw as well as the cooked samples of meat, which were homogenised before sampling. In most of the recipes the riboflavin content increased on cooking. This increase is accounted for by the addition of ingredients like spices, peas, other vegetables and curds. In Keema Matar ½ the daily requirement of riboflavin for adult is met through one serving of any one of the cuts containing 60 g. of pork. Other recipes contribute 1/5th to 1/6th of the day's requirement of riboflavin.

Apart from enhancing the protein quality, these recipes can make a valuable contribution to the riboflavin content of the diets of Indians, if pork is popularised among the common people.

Non traditional foods can thus be experimented upon and turned out as attractive and acceptable recipes. Widespread consumer education is needed on the proper use of the non traditional foods by means of the food demonstrations. For puposes such as these the information given in this section as standardised recipes can be of great value.

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